The Alberta Journal of Educational Research

Vol. XVI, No. 4 *December, 1970*

CONTENTS

The Effectiveness of Computer-Assisted Instruction 203
A. J. Cropley and P. F. Gross

An Experiment in Attitude Change 211
D. Friesen and C. S. Bumbarger

A Soviet and Western Concept of Set 217
John Hritzuk and Henry Janzen

Salary Structure and Education of Alberta Teachers 227
Rick Odegard and Dave Shapiro

Changes in Elementary and Junior High School Ecology in an Urban School District 241
Helen L. Pierce

The Effects of Question Sequence Upon Objective Test Performance 253
Donald L. Peters and Victor Messier

BOOK REVIEWS

Thomas Carter, *Mexican Americans in School: A History of Educational Neglect* (New York: College Entrance Examination Board, 1970), D. Wangler 267

Lee J. Cronbach, *Essentials of Psychological Testing.* Third Edition (New York: Harper and Row, 1970), V. R. Nyberg 269

John Macdonald, *The Discernible Teacher* (Ottawa: Canadian Teachers' Federation, 1970), S. C. T. Clarke 271

FACULTY OF EDUCATION
The University of Alberta

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

A. J. CROPLEY
and
P. F. GROSS[1]
University of Saskatchewan

The Effectiveness of Computer-Assisted Instruction

A recent addition to the rapidly expanding educational technology is that of computer-assisted instruction (CAI). In the study reported here, a group of university students received instruction in FORTRAN programming via remote terminals linked to a computer over 400 miles away. Comparison of the effectiveness of the computer teaching with that of conventional lectures and programmed instruction led to the conclusion that all three methods were about equally effective. No serious negative feelings about being taught by machines were reported by the students. Thus, CAI looks to be an acceptable and effective instructional aid in certain subject areas.

One of the major recent developments in education involves the increasing use of teaching procedures which do not follow the traditional, textbook oriented, expository model. Among the new procedures coming into increasing use are programmed instruction, teaching machines, and now, computer-assisted instruction (CAI). It is usual to conceptualize the CAI process as based on learning theory (e.g. Skinner, 1957), so that its purpose is often stated as being to establish specific discriminated operants by shaping responses through differential reinforcement (Reynolds, 1968).

Instruction with the aid of a computer has a number of advantages over other methods of programmed instruction. The computer can communicate with a learner and decide what should be done after he has responded. It can compare his responses with a list of anticipated responses, and can handle unexpected responses in a meaningful way, for example by referring the learner to a page in a text, or by reminding him of some basic principle which his answer has violated. The use of

1 At present Woodrow Wilson Fellow at Woodrow Wilson School of Public and International Affairs, Princeton University.

the computer makes it possible to introduce a very large number of branches into a program, so that the learner is not compelled to move only forward or backward along an instructional track. The computer can participate in the education of dozens of students at a time, each one receiving individual attention, and it can do all this at a distance of hundreds of miles if necessary, via for example, telephone line hookups. Thus, one of the most important advantages of computers in schools lies in their potential for individualizing the educational process (Cooley and Glaser, 1969).

However, despite the enthusiasm with which its proponents advance the claims of CAI (e.g. Mitzel, 1968; Saunders, 1968), and the counter arguments with which its shortcomings are stressed (e.g. Oettinger and Marks, 1969), one point which is not absolutely clear is whether or not CAI works. Do students who are taught via CAI acquire the desired skill as efficiently as they do when taught by conventional classroom exposition? As Suppes and Morningstar (1969) point out in reporting favourable results of CAI in the teaching of high school mathematics and elementary Russian, relatively little is known about how efficient CAI really is. It is, in fact, this question with which the data in the present paper are concerned, the particular skill taught by CAI being FORTRAN programming.

One comparable study involving CAI teaching of FORTRAN was conducted by Schurdak (1967). He divided 48 university students into three groups of 16 each, one group taking conventional instruction (TAI), one using a programmed instruction text only (PI), and the third being taught by CAI. He reported that the CAI group did significantly better than the other groups, and that both CAI and PI groups completed the course in less time than did the TAI group. The present study was concerned with several similar questions: Can undergraduates be taught FORTRAN programming as effectively by CAI as by conventional classroom procedures? How does CAI compare with TAI as far as consumption of students' time is concerned? Do CAI students report negative feelings about being instructed by machine?

Method

Subjects

The subjects from whom the data involved in the study were obtained were all members of what was, in effect, an introductory programming class at the University of Saskatchewan Regina Campus. The group consisted of a total of 76 students, 61 men and 15 women.

Tests

The tests used fell into two categories, involving pre-tests on the one hand, and post-tests on the other. The purpose of the pre-tests was

to make possible preliminary matching of the experimental groups which were to be taught the FORTRAN language by three different procedures, TAI, PI, and CAI. Such *a priori* matching was necessary so that any outcome could not be dismissed as simply an artifact of pre-existing intellectual differences among the experimental groups. The pre-test scores employed in this preliminary matching were obtained from the subtests of the Primary Mental Abilities Test (PMA). The test yields scores on four subscales, Verbal Meaning, Number Facility, Reasoning, and Spatial Relations, four of the eight or so basic abilities which Thurstone (1948), the designer of the test, believed are fundamental to all intellectual functioning, either acting separately, or else combining to form more complex abilities.

Post-test scores were obtained from a variety of "subjective" instruments (involving the exercise of discretion by the scorer) specifically designed for this project, and four relatively "objective" measures (like, for example, total time spent in actual formal study of the FORTRAN language). The subjective tests included three FORTRAN tests, four FORTRAN problems, and a final examination. More objective criterion measures, characterized by the fact that they involved data not derived from judgments on the part of raters and, in the case of the CAI group sometimes actually recorded by the computer, included total time spent in formal study of the FORTRAN language and number of runs required to obtain a correct solution for each of the four problems.

Hardware and Software

The mainframe computer was a 512K IBM 360/67 located at Edmonton, some 434 miles from Regina. The terminals used were two IBM 2741 typewriter keyboard terminals, linked to the IBM 360/67 processor and its associated IBM 2314 DAS device by means of a dedicated, leased telephone line, in the initial stages of the study, and then via a dial up long-distance telephone circuit linked to a multiplexor at the Edmonton end.

The programming language in which the CAI lessons were written was the APL language (Iverson, 1962).[2] This language which is quite similar to normal mathematical notation, has several advantages for programmers (Gross, Cropley, Hebb and Palmer, 1969), but since they are not strictly relevant to the purposes of this paper they will not be presented in detail here.

Procedure

The PMA test, from which the pre-test scores were derived, was administered to the entire class in a single group session, following the

[2] The authors are greatly indebted to Messrs. R. Palmer and B. Hebb for their skilful construction of the APL language programs by means of which the CAI was carried out.

procedures specified in the test manual (Thurstone, 1963). Subsequently, the test protocols were scored according to the published key. No scaling or transformation was carried out on the raw PMA data (for example, by converting them to IQ scores), as such procedures involve, for example, making age corrections which were not made on any of the other data obtained.

Subsequent to the administration of the pre-tests, the students were told they could elect to receive their instruction in the FORTRAN part of the class by one of three methods, CAI, PI, or TAI, and they were assigned to instruction groups on the basis of these stated preferences. Because too many students for the available facilities nominated CAI as the preferred mode of instruction, a few students had to be assigned to the group of their second choice. In view of the pervasiveness of sex difference in cognitive skills (Bayley, 1968), it is worth noting that the composition of the three instruction groups, according to sex, was almost perfectly random ($X^2=0.14$; $df=2$).

Having been allotted to an instruction group, the students then completed their FORTRAN class according to the method appropriate to their group. The FORTRAN problems were set at intervals during the two weeks over which the formal lectures extended, CAI and PI students receiving the problems on request. On solving these problems the students handed in their solutions (programs) plus appropriate documentation. Marks were assigned to these solutions by the instructor responsible for the class, regardless of which instructional group the student submitting them belonged to.[3] The number of runs required by each student to obtain his solutions to each problem (to debug his programs) was recorded by the computer on which the debugging runs were conducted, at the time of attempted compilation.

Similarly, the three FORTRAN tests were administered to the TAI students at intervals, while CAI and PI students attempted them at their own discretion. Finally, all students attempted a formal final examination which included a section on FORTRAN. Scoring of the FORTRAN tests and the final examination was again the responsibility of the instructor in charge of the class.

During the acquisition phase of the study, total time in minutes for completion of formal instruction was recorded. For CAI students, this time was taken as the time actually spent working at the terminal, and was recorded in minutes by the computer. In the case of the PI students, this time was the total time in minutes that they spent working on the PI text, and was recorded and reported by the students themselves. A single time of 300 minutes was recorded for all of the TAI students (6 lectures of 50 minutes' duration), regardless of absenteeism.

---

[3] The authors are greatly indebted to Mr. M. Day, the instructor in charge of this class, whose active participation in the project made its completion possible.

Data Analysis

The first stage of the data analysis involved comparison of the three experimental groups on the PMA subtests. This comparison, aimed at indicating the degree to which the three instructional groups were matched in ability prior to the commencement of instruction, was conducted using the two-way analysis of variance procedures suggested by Winer (1962, pp. 241-244), analyzing sex data separately.

The initial analysis of the post-test data involved calculation of product-moment correlations among the various variables. Subsequently, the means of the three instruction groups were compared, again using the two-way analysis of variance procedures outlined by Winer (1962, pp. 241-244).

Results

The preliminary analysis of variance on the pre-test data indicated that the groups were adequately matched as far as their intellectual capacities were concerned. The only significant mean difference on PMA data was associated with sex, and involved Number Facility, in which case the males surpassed the females ($F=7.80$; $df=1/70$; $p<.01$).

In the case of the post-test (criterion) data, it was not possible to obtain all data from all subjects, for a variety of reasons including the failure of automatic recording systems, human forgetfulness, and so on. In fact, a complete set of criterion data was obtained from only 44 out of the 76 participating students. Consequently, in order to avoid loss of about 1/3 of the total information which was obtained, analysis of the post-test data was not restricted to the subjects for whom it was complete, but was based on all data available for each particular criterion variable considered separately. Thus, there are variations in the numbers of subjects on whom the various between-group comparisons are based.

Correlation coefficients among the various criterion variables added to the construct validity of these measures. For example, the three FORTRAN tests correlated highly among themselves (median=.66; range=.58—.74). Similarly, the four FORTRAN problems defined a clear cluster of scores (median intercorrelations=.43; range=.14—.48), as did the number of runs needed for solution of the various problems. The three FORTRAN tests all correlated with scores on the final exam FORTRAN grade beyond the .01 level of significance. Thus, the correlational data suggest that a relatively stable and pervasive set of criterion attributes was being measured by the post-tests.

A summary of the analyses of variance on the 14 criterion variables is shown in Table 1. The number of degrees of freedom associated with the denominators of the F ratios varies widely, although the df for the numerators is constant (1 for sex, 2 for instruction groups, and 2

for interactions). The appropriate number of degrees of freedom for each *F*'s denominator is shown in the table. Where no data are missing, these *F*'s have 70 degrees of freedom in the denominator.

TABLE 1

SUMMARY OF Fs FOR POST-TEST DIFFERENCES BETWEEN INSTRUCTIONAL GROUPS DIVIDED BY SEX

Variable	Fs			df for F
	Sex	Instructional Groups	Interaction	
Fortran Test 1	2.59	4.11*	0.44	70
Fortran Test 2	0.54	3.93*	1.41	62
Fortran Test 3	2.21	2.66	0.22	50
Total Time	1.13	186.39**	0.41	65
Fortran Problem 1	0.10	0.37	0.40	68
Fortran Problem 2	10.95**	1.49	1.50	62
Fortran Problem 3	0.57	0.65	4.78*	56
Fortran Problem 4	0.01	0.66	0.01	69
Number of Runs 1	0.83	0.26	1.55	68
Number of Runs 2	0.32	1.96	2.95	62
Number of Runs 3	0.48	0.44	0.68	57
Number of Runs 4	1.45	0.91	2.13	69
Fortran Final Grade	1.91	0.27	0.30	67
Final Grade	0.52	0.08	0.31	64

*P < .05
**P < .01

Discussion

There were very few cases where the groups differed significantly on the criterion variables. There were significant differences on the first two FORTRAN problems, but an examination of the means of the three instruction groups on these two variables indicates that the significant *F*'s resulted from superior performance, not on the part of the CAI group, but of the PI group, which surpassed both other groups. Means and standard deviations of the three groups on these two variables are shown in Table 2.

The data for total time suggest the source of this superiority of the PI group on the FORTRAN tests, a superiority, it is worth noting, which did not extend to the FORTRAN problems in which actual application of formal principles is required, rather than merely their enunciation. The PI group spent much longer in formal preparation

TABLE 2

MEANS AND STANDARD DEVIATIONS OF INSTRUCTIONAL GROUPS ON FORTRAN PROBLEMS 1 AND 2

		Fortran Test 1			Fortran Test 2		
		CAI	PI	TAI	CAI	PI	TAI
Males	N	12	14	35	11	11	32
	Mean	39.2	41.6	35.2	31.8	34.5	31.8
	SD	6.22	5.83	7.04	6.97	4.00	6.01
Females	N	4	4	7	4	4	6
	Mean	39.8	46.3	39.3	34.5	38.8	28.8
	SD	4.32	2.27	3.41	2.17	3.56	5.92
			$F = 4.11^*$			$F = 3.93^*$	

*P < .05

than did the other two groups. The *F* for total time of 186.4 is clearly inflated by the fact that the absence of any variation in the times recorded for TAI sudents (all of whom were treated as having spent 300 minutes in formal preparation) greatly reduced the error term. Nonetheless, the mean preparation time for the male PI students was 711 minutes, compared with 215 minutes for CAI and 300 minutes for TAI, while the figures were 762 minutes, 239 minutes and 300 minutes respectively for the handful of women for whom data were available.

Finally, the results of the students' responses to a questionnaire concerning their feelings about being taught by a machine are worth considering at this point. Only one CAI student agreed that instruction by computer made him feel that "no one really cared whether I learned or not". Again, only one student disagreed with the statement that "while taking CAI I felt challenged to do my best work". Almost without exception, the students reported no feelings of isolation, but rather that they felt as though they were engaged in conversation. All CAI students but two reported that they felt inspired to seek more knowledge about the subject matter they had been taught by CAI. In the main then, CAI students did not find the experience dehumanizing, were not distracted by the hardware, and were favourably disposed towards more CAI.

In summary, the present data indicate that CAI students did just as well on a number of outcome measures as did those who were taught in a conventional classroom, and that, overall, both these modes of instruction led to end-results about similar to those achieved via PI. CAI compared favourably with TAI as far as time was concerned too. Finally, the students who received their instruction from the computer found the experience quite acceptable as far as their emotional response to it was concerned. All of these findings suggest that CAI is a realistic

and acceptable alternative to traditional classroom procedures in appropriate situations. Although they would not support the claim that CAI should immediately be implemented across a wide band of the instructional spectrum, they certainly suggest that, in the light of possibilities of cost reduction with the wider use of CAI, and of the opportunity that CAI offers to relieve human instructors of a routine instructional task in some subject areas, it has good potential as a valuable educational instrument.

References

Bayley, N. Behavioural correlates of mental growth. *American Psychologist,* 1968, *23,* 1-17.

Cooley, W. W., & Glaser, R. The computer and individualized instruction. *Science,* 1969, *166,* 574-581.

Gross, P. F., Cropley, A. J., Hebb, B., & Palmer, R. APL and remote terminal usage. Paper read at British Computer Society Conference DATAFAIR 69, Manchester, August 27th, 1969.

Iverson, K. E. *A programming language.* New York: Wiley, 1962.

Mitzel, H. On narrowing the credibility gap for computer assisted instruction. In *Proceedings of conference on computers in education,* University of Saskatchewan Regina Campus, 1968.

Oettinger, A., & Marks, R. *Run, computer, run: The mythology of educational innovation.* Harvard: Harvard University Press, 1969.

Reynolds, G. S. *A primer of operant conditioning.* Glenview, Illinois: Scott, Foresman, 1968.

Saunders, R. Computer assisted learning: A progress report. *Journal of Engineering Education,* 1968, *58,* 927-930.

Schurdak, J. An approach to the use of computers in the instructional process and an evaluation. *American Educational Research Journal,* 1967, *4,* 59-73.

Skinner, B. F. *Verbal behaviour.* New York: Appleton Century Crofts, 1957.

Suppes, P., & Morningstar, M. Computer assisted instruction. *Science,* 1969, *166,* 342-350.

Thurstone, L. L. Psychological implications of factor analysis. *American Psychologist,* 1948, *3,* 402-408.

Thurstone, T. G. *Manual for the Primary Mental Abilities Test.* Chicago: Science Research Associates, 1963.

Winer, B. J. *Statistical principles in experimental design.* New York: McGraw Hill, 1962.

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

D. FRIESEN
and
C. S. BUMBARGER
The University of Alberta

An Experiment in Attitude Change

One of the assumptions of conferences is that a change in the attitude of participants will be effected during the proceedings. A report of an experiment to obtain empirical evidence to test the assumption is contained in this article. Tests were given before and after a conference on data processing in education, to check for changes in attitude toward the concept. A significantly more favourable attitude toward data processing in education was revealed after the conference as compared to that held prior to the conference. A further test six months later indicated an almost complete regression to the original attitude.

The annual invitational Conference of School Administrators at Banff deals with problems of special interest to school administrators across Western Canada. One of the aims of the Conference is to effect a change in attitude on the part of the participants toward a particular theme. The aim of the research reported below was to assess the degree to which this goal was achieved in the 1968 Conference on Data Processing in Education. The question to which an answer was sought was this. Did the attitude of the participants after the Conference differ significantly from that which existed before the Conference?

Methodology

On the basis of previous experiments the semantic differential test was deemed an appropriate instrument for measuring the attitude toward data processing in education.

Two parallel forms, each containing thirteen scales, of an attitude inventory toward data processing in education were developed on the basis of Osgood's work (1957). The method has been employed to measure the meaning of an object or concept to an individual, and his attitude toward it (Selltiz, 1966). The seven-point scale is comprised of

bipolar positions such as fair-unfair, clean-unclean, good-bad, and active-passive. The responses of groups and sub-groups can be summated to yield scores that indicate attitudes toward the object being rated.

The Development of the Parallel Forms

Roget's Thesaurus was searched for pairs of adjective antonyms considered suitable or appropriate when related to the theme under review. Seventy-eight pairs were chosen for the pilot study. The resulting test was administered to seventy-nine graduate students and faculty members at The University of Alberta.

The data of the pilot study were factor analyzed which yielded the correlation between items, the mean and standard deviation of each item, and the factors on which the items loaded. This analysis formed the basis of choosing scales for the two forms of the semantic differential instrument.

The following criteria were used in the selection of items for the two forms:

(a) pairs of items had to have an r greater than .60
(b) items had to have a S.D. greater than 1.0
(c) items had to have a mean score of less than 3.0 or greater than 5.0 (discriminatory items).

The thirteen pairs of items that met these criteria were then assigned at random to each of Form A and Form B of the instrument. The thirteen items plus three "dummy" items in each form were randomly ordered and six from each form, randomly chosen, were reversed.

Further tests revealed a correlation of 0.94 between the two Forms. The total mean scores and standard deviations for the Pilot Study sample are given in Table 1.

TABLE 1

MEAN AND STANDARD DEVIATION OF TWO FORMS OF SEMANTIC DIFFERENTIAL TEST

	Mean	S.D
Form A	68.18	12.89
Form B	67.39	13.55

Factor analysis (principal axis with varimax rotation) yielded three factors accounting for 69.8 per cent of the total variance for Form A and 71.4 per cent for Form B.

Form A was used as a pretest and Form B as a post-test for the attitude toward data processing in education. Six months later Form A was used again as a follow-up to examine the persistence of the change in attitude.

Sample

Superintendents, school board members, and secretary-treasurers of school boards participated in the Conference. Forty-five of these members completed both the pre-test and post-test, and forty responded to the follow-up.

The results of the analyses of Conference participant responses to Form A are compared to those of the Pilot Study in Table 2. The mean score of the participants, though slightly more favourable than that of the pilot study group, was not significantly different from it. There was, however, less variation in the Banff Conference group than in the initial sample. The attitude of the group thus appeared less divergent than that of the university sample, but, on the average, not significantly different from it.

TABLE 2

ATTITUDE TOWARD DATA PROCESSING IN EDUCATION

	Mean	S.D.
Pilot Study Group	68.18	12.89
Banff Conference Participants	69.98	9.85

Findings

Several observations may be made on the basis of the data presented in Table 3.

TABLE 3

ATTITUDE CHANGE TOWARD DATA PROCESSING IN SCHOOLS:
TOTAL BANFF CONFERENCE GROUP (N=45)

	Mean	S.D.
Pre-test	69.98	9.85
Post-test	77.53	8.79

The significant increase in the mean score of the Banff group after the Conference provides support for the contention that a change in attitude did occur during the three days. This change was in the direction of a more favourable view of data processing in education.

To ascertain whether this more favourable view was of a permanent nature, the participants were asked to respond to Form A six months after the Conference. The analysis of these results, together with those of the pre-test and post-test are given in Table 4.

TABLE 4

ATTITUDE CHANGE TOWARD DATA PROCESSING OVER TIME: TOTAL BANFF CONFERENCE GROUP

	N	Mean	S.D.
Pre-test	45	69.98	9.85
Post-test	45	77.53	8.79
Follow-up	40	70.68	9.57

The mean score of the Conference group as a whole had returned to about the same level as prevailed before the experiment. The results suggested that the change in attitude effected by the Conference had disappeared six months later, and that data processing was again viewed as if the experiences and the change at the Conference had never occurred.

To provide further analysis of the findings the data were broken down by the three participating groups. However, since the numbers in these groups were small no statistical tests were conducted. Figure 1 provides the comparison between the groups for the three test periods.

Three interesting observations derived from the analysis. First, all three groups made significant gains toward a more favourable mean score during the conference. Second, all three groups ended up with relatively the same mean score. Third, only the secretary-treasurers' group maintained its gain over the period of six months following the conference. Both the educational administrators and the trustees returned to their original attitudinal positions toward data processing in education.

Further analyses were carried out to test differences in attitudes among different groups. The attitude toward data processing in education was not linked significantly to such variables as age, education, experience, position held, district size, and the degree of acquaintance with data processing.

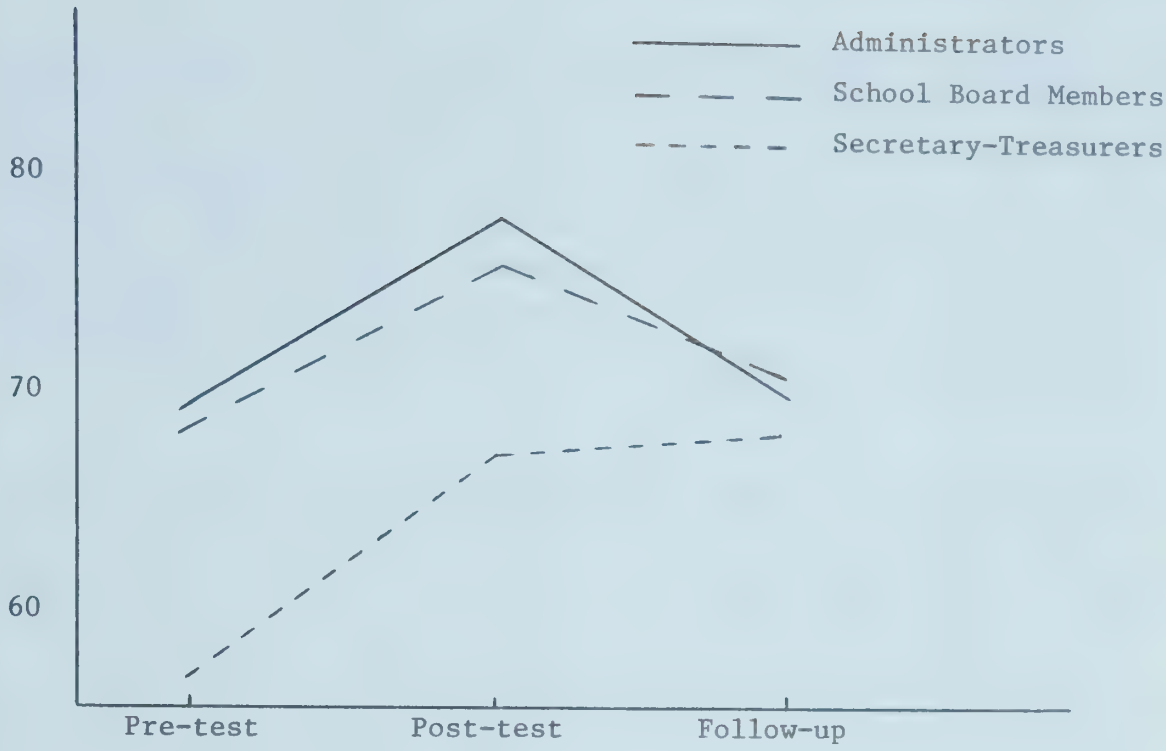

FIGURE 1

MEAN SCORES OF THREE GROUPS ON ATTITUDE
TOWARD DATA PROCESSING IN EDUCATION

Observations

The findings of this experiment casts some doubt on the value of the single conference approach to changing attitudes. Quite likely, a profound change may need sustaining "input".

The Hawthorne effect may be operative in conferences and may color the evaluations often attempted at the end of the sessions. For more objective assessments of the effect of experiences, evaluations need to be performed after considerable time has elapsed.

Different groups may be affected differently by conference proceedings. In this experiment, the two groups often considered leaders in education, responded positively to the change in attitude immediately after the conference, but lost this favourable point of view. The other group seemed to maintain its change.

Implications

The semantic differential approach may provide a convenient and effective approach to examine attitude changes in people undergoing planned experiences. It is a simple and versatile instrument and yields data for several approaches to attitude change. Not only the total attitude can be examined but so can the factors. If the findings could

be extended to change in general, several interesting suggestions may be offered. Conferences may need to be augmented with on-going activities to keep alive the changes that seem to occur. Follow-up procedures ought to be studied and invoked. In order to keep the attitude toward a change highly positive there must be the recognition that without involvement and reinforcement, regression toward the initial attitude position is likely to occur. The single conference may be a start toward attitude change, but, contrary to common belief, it does not appear to be a potent force for such change.

References

Osgood, C. E., *et al. The Measurement of Meaning.* Urbana: University of Illinois Press, 1957.

Selltiz, C., *et al. Research Methods in Social Relations,* New York: Holt, Rinehart and Winston, 1966, 380-382.

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

JOHN HRITZUK
and
HENRY JANZEN
The University of Calgary

A Soviet and Western Concept of Set

Uznadze's term ustanovka *and Luchins' term* Einstellung *are translated as* set *in Western psychological writing. Luchins refers to* Einstellung *as habituation or rigidity in behavior. For Uznadze,* ustanovka *is the mobilization or a readiness of an individual for activity in a certain direction. In this study, the equivalent meaning of* ustanovka *and* Einstellung *was investigated. Fifty-one subjects were tested using Uznadze set tasks and Luchins Hidden Word Test. Individuals were compared on their ability to fixate and extinguish a set in both experimental approaches. A Chi-square test was used in the statistical analysis. Subjects performed similarly on both experimental tasks, thus substantiating a similarity between Luchins' and Uznadze's concept of set.*

The concept of *set* has been with us for nearly the entire history of psychology (Luchins, 1966). During that time, a variety of explanations have been proposed to account for its existence. No one conceptualization has been adequate, probably because the nature of set is very complex. One school of psychology in the U.S.S.R. at Tbilisi deals with *ustanovka* or set; research was conducted by Uznadze as early as 1923 and today by many of his students at the Uznadze Institute. In the West, there is no comparable institute dealing with set. However, A. S. Luchins has done considerable work with *Einstellung* (set) with regard to problem solving. Although both *ustanovka* and *Einstellung* are translated as "set," there is danger in assuming equivalence of psychological terms without a theoretical and empirical examination (Hritzuk, 1968). The purpose of this paper is to examine and compare *set* from Luchins' and Uznadze's points of view.

Luchins on Set

The concept of set is used to support the idea that an organism does not react passively to stimuli, but selects stimuli and directs its

responses. On the other hand, behaviorists, who explain behavior in terms of stimuli and responses, have been opposed to the concept of set. However, there has been some acceptance of set from research in perception and from the neobehavioristic approach to verbal learning (Luchins, 1966).

Luchins (1942, 1946, 1950, 1954, 1955) has investigated *Einstellung* which he translates as set, mental set and habituation. His experiments focus on problem solving, and in particular whether in solving a series of problems one develops mechanization of behavior, a rigidity or a tendency to continue the solution of problems in a manner similar to subsequent solutions. Luchins says:

> *Einstellung*—habituation—creates a mechanized state of mind, a blind attitude toward problems; one does not look at the problem on its own merits but is led by a mechanical application of a used method . . . *Einstellung* produces a surprising failure to solve a simple problem . . . as it "blinded" subjects to direct solutions (Luchins, 1942, 15).

Luchins (1942) shows the effect of *Einstellung* as a mechanization in problem solving. As a result, set has an important role in classroom situations (Luchins, 1946, 1955). The *Einstellung* test is used as a test of rigidity in normal and abnormal subjects (Luchins, 1946). In addition, Luchins (1951) relates set to the level of abstraction as measured by a sub-test of the Wechsler-Bellevue Intelligence Scale. In all cases, there appears to be a positive relationship between *Einstellung* and the experimental variables examined by Luchins.

Luchins' Method of Experimentation

Luchins (1946) describes several methods which he uses for the *Einstellung* test; however, the water jug problems and the Hidden Word Test are most commonly used.

In the water jug problem, there are eleven problems to solve. For example, the student is given an empty 21 quart jar (A), an empty 127 quart jar (B), and an empty 3 quart jar (C). He is required to measure out 100 quarts of water. The following water jug problems are used:

1. problems 1 to 6 create the set;
2. problems 7 and 8 are the critical tests which test for the existence of set;
3. problem 9 tests for experimental extinction;
4. problems 10 and 11 test for recovery from *Einstellung.*

Problems 2 to 6 are solved by the formula B-A-2C; they are called the E problems. Problem 7, 8, 10 and 11 are solved by the E method and also by A-C or A+C. Problem 9 is solved only by A-C method.

An alternative method to the water jug problem is the Hidden Word Test. Utilizing the sequential order described in the water jug problems, the subject is asked to identify the hidden word in each of eleven non-

sense words. For example, *msavroe* has the hidden word mare. The third word *dzepewr* has the word deer. Each second letter is used to form the hidden word, and thus the *Einstellung.*

Luchins (1966) is concerned with maximizing and minimizing the *Einstellung* effect. For example, by presenting the problem as a stressful speed test may maximize *Einstellung,* while by giving the subject a warning may minimize the *Einstellung.*

Uznadze on Set

Set or *ustanovka,* as a term underlying human activity, does not pretend to explain every facet of human behavior. However, Uznadze (1961) states that activity has a definite relationship to set. For Uznadze, set is the mobilization or a readiness of the individual for activity in a certain direction. One is usually not aware of sets operating at any time; it is this activity which Uznadze calls the unconscious. Set arises in the presence of a basic perception, a need, and a situation to satisfy the need. Uznadze points out that needs may be substantive (organic), functional (need for activity), or intellectual. In addition, there are two levels of human behavior. The first plane is the level of impulse actions in which man is stimulus bound. The second level gives man increasing independence of response from immediate stimuli; this level is associated with objectification. The theory has been previously discussed in greater detail (Hritzuk, 1968, 1969).

Set, as Uznadze defines it, provides one with a new model of behavior. One acts in a certain manner due to the influence of fixed sets operating at the time. It is possible to change one's behavior but this implies the use of will; man is not a machine or a robot who has no control over his behavior, but the amount of control that one has depends upon his ability to objectively perceive situations. Uznadze emphasizes that man is a superior animal who has the ability to see the world as it is and to note that he is part of it. On a practical level, this means that once the smooth course of activity is in some way disrupted, a man cognitively reassembles the circumstances to develop a new set (*ustanovka*) which re-directs his activity (Uznadze, 1958).

Uznadze's Method of Experimentation

Although there are several methods of investigating *ustanovka,* the haptic and visual modalities are most commonly used. Two spheres of equal weight, but of unequal size, are presented for short periods to a blindfolded subject. The spheres are presented briefly to a subject, the larger sphere in the right hand, the smaller sphere in the left hand. The first exposures to the unequal spheres, called the set tests, results in a set arising in each case to evaluate the spheres as larger or smaller.

Following several trials of unequal spheres, two equal spheres, the critical tests, are presented. The critical tests disclose the presence of a fixed set developed in accordance with the preceding set tests since the subject evaluates one of the two spheres of equal size as "larger" or "smaller."

In the critical tests, a subject may experience two types of illusions: contrast or assimilative. A contrast illusion results when during the critical tests (equal spheres), the sphere is perceived as smaller in the hand which during the set trials had the larger sphere. If the sphere is perceived as larger, then an assimilative illusion has developed. Excitability or fixation of set is the ease with which an illusion is formed.

When the subject perceives the two equal spheres as unequal, a minimal level of set is established. To extinguish *ustanovka,* the critical trials are continued until the spheres are perceived veridically for five consecutive trials.

One uses equal and unequal circles to study set in the visual modality. Circles are flashed at 1/10 of a second in a tachistoscope. Again the subject evaluates the circles as equal or unequal, during set tests and critical tests (Hritzuk, 1968).

An Experimental Comparison: Luchins and Uznadze

Sample

To compare experimentally *Einstellung* and *ustanovka,* 51 subjects were chosen for the study. The sample consisted of 31 females and 20 males, with a mean age of 20.5.

Instruments

1. The Luchins Hidden Word Test consists of 12 nonsense words with one serving as an example. The word test for Luchins' *Einstellung.*
2. Uznadze set tasks consist of 3 spheres and 4 circles to test for *ustanovka* in the haptic and visual modalities (Hritzuk, 1969).

Procedure

In the Hidden Word Test, a subject is asked to find in each nonsense word a hidden four or five letter word without transposing the order of the letters. The first six words are solvable only by choosing every second letter in the list to make an animal name. If a subject completes the seventh and eighth words with the name of an animal, a set has occurred. If no animal name is given, no set occurred. The number of subjects with and without set occurrence was recorded. Re-excitation of the original solution method occurs in words 10 and 11. If animal names re-occur, there is no extinction; if no animal names occur, there is

extinction. The number of subjects who experience extinction was recorded. If the subject chooses one animal name in words 10 or 11, a weak extinction occurs.

To test for *ustanovka,* each subject was presented the unequal and equal spheres to test for fixation of set in the haptic modality. When the minimal level of trials was established, the critical tests were repeated to test for set extinction. The subjects were recorded as to their ability to fixate and extinguish set in the haptic modality. The test for set fixation and extinction in the visual modality was conducted immediately following the haptic tests. Again, the number of subjects who fixated and extinguished a set was noted.

From both tests, the resulting categories were:

1. set
2. no set
3. extinction
4. weak extinction (Luchins test only)
5. no extinction.

Analysis

Responses were categorized for each subject on the Luchins and Uznadze tests and comparisons were analyzed using Chi-square.

The hypotheses tested was that no significant differences exist between the observed and expected frequencies on excitation and extinction trials between the Western and Soviet test results. The critical level of significance was .01.

The first analyses compares the number of subjects who excite a set in the haptic and visual modalities using Uznadze's test with the number who excite a set on Luchins' test. Results are reported in Table 1 and Table 2.

TABLE 1

EXCITATION OF SET IN THE HAPTIC MODALITY AND THE HIDDEN WORD TEST

Luchins Test	Haptic Modality		Totals
	Set	No Set	
Set	30	2	32
No Set	17	2	19
Totals	47	4	51

Chi-square = .58; not significant at the .01 level

TABLE 2

EXCITATION OF SET IN THE VISUAL MODALITY
AND THE HIDDEN WORD TEST

Luchins Test	Visual Modality		Totals
	Set	No Set	
Set	22	9	31
No Set	16	4	20
Totals	28	13	51

Chi-square = 4.01; not significant at the .01 level

A χ^2 value of 6.64 is needed for significance; the obtained χ^2 of .58 and 4.01 is not statistically significant.

The second analyses compares the number of subjects who extinguish a set in the haptic and visual modalities on Uznadze's test with the number who extinguish a set on Luchins' test. Results are reported in Table 3 and Table 4.

TABLE 3

EXTINCTION OF SET IN THE HAPTIC MODALITY
AND HIDDEN WORDS TEST

Luchins Test	Haptic Modality		Totals
	Extinction	No Extinction	
Extinction	3	0	3
No Extinction	33	15	48
Totals	36	15	51

Chi-square = 1.31; not significant at the .01 level

Again no significant differences were obtained.

The third analyses involved the addition of a "weak extinction" category to "extinction" and "no extinction" on Luchins' test. The category seemed necessary since a number of subjects would choose an animal name from one of words 10 or 11. The results are reported in Table 5 and Table 6.

TABLE 4

EXTINCTION OF SET IN THE VISUAL MODALITY
AND THE HIDDEN WORD TEST

Luchins Test	Visual Modality		Totals
	Extinction	No Extinction	
Extinction	0	3	3
No Extinction	30	18	48
Totals	30	21	51

Chi-square = 4.55, df = 2, P<.01; not significant at the .01 level

TABLE 5

EXTINCTIONS OF SET IN THE HAPTIC MODALITY AND HIDDEN
WORDS TEST WITH AN ADDED EXTINCTION CATEGORY

Luchins Test	Haptic Modality		Totals
	Extinction	No Extinction	
Extinction	3	0	3
Weak Extinction	9	2	11
No Extinction	24	13	37
Totals	36	15	51

Chi-square = 2.47; not significant at the .01 level

TABLE 6

EXTINCTION OF SET IN THE VISUAL MODALTIY AND HIDDEN
WORDS TEST WITH AN ADDED EXTINCTION CATEGORY

Luchins Test	Visual Modality		Totals
	Extinction	No Extinction	
Extinction	1	2	3
Weak Extinction	7	4	11
No Extinction	24	13	37
Totals	32	19	51

Chi-square = 1.33; not significant at the .01 level

Even with the addition of a category, no significant differences were obtained. A χ^2 value of 9.21 was needed for significance.

The null hypothesis was accepted for each test. No significant

differences were found between Uznadze's and Luchins' method of testing for set excitation and extinction.

Discussion

After an examination of both theoretical and empirical aspects of *Einstellung* and *ustanovka,* some similarities and differences may be observed in the two concepts of set.

For Luchins, *Einstellung* enables one to persevere in an habitual mode of response. He implies that set is more synonymous with habituation in behavior than with a form of readiness. Both Luchins and Uznadze emphasize the central, cortical nature of set. However, unlike Uzandze, for Luchins set is auxiliary to activity, and he has not developed a theory of set. For Uznadze, set is a cortical phenomenon, an integrity which is basic to behavior. Uznadze does not use the term "mental set," however, set is basic to cognition, since it plays an important role in objectification, thought and memory. Luchins does not give set the same importance in behavior.

The experimental part of Luchins' work has similarities to those of Uznadze, namely, the ideas of set fixation and set extinction. Spheres and circles are used to test for set if one takes Uznadze's approach, while words are used in Luchins' approach. The experimental procedure used by Luchins is more simple compared to Uznadze's method. By using the Soviet approach, one can be more thorough in testing for irradiation, generalization and the number of optimal and minimal trials necessary for set fixation and extinction.

Since the experimental analysis leads to no significant differences between the two theories in set fixation and extinction, there may be more similarities than the literature indicates. *Einstellung* which is defined as "mental set" appears to be similar to *ustanovka* or "set." One may hypothesize that set may not necessarily reflect the impulsive level of behavior. While instructing the subject on the procedure of testing, one is creating a need and thus a readiness to respond in both Uznadze's and Luchins' test. In one case the response is oral, in the other it is written; both procedures may involve cognitive activity. Due to the similarities of results, it may be possible to substitute Luchins' test, which is easier and faster to administer. However, Uznadze's procedure does enable one to examine set characteristics in greater detail, in addition to set fixation and extinction. Further experimentation of the two theoretical approaches may add to the clarification of *Einstellung* and *ustanovka.* If the terms are equivalent in meaning, then one may use the terms interchangeably in psychological research.

References

Hritzuk, J. An experimental and comparative application of the psychology of set. In A. Prangishvili (Ed.), *Eksperimental'nye Issledovaniia po Psikhologii Ustanovki,* vol. V. Tbilisi: U.S.S.R., Academy of Sciences, 1968.

Hritzuk, J., Unruh, W., & Hertzog, R. Some Soviet approaches to the study of personality. *The Canadian Psychologist,* 1969, *10,* No. 1, 32-48.

Luchins, A. S. Mechanization in problem solving. *Psychological Monographs,* 1942, *54,* 1-95.

Luchins, A. S. Classroom experiments on mental set. *American Journal of Psychology,* 1946, *59,* 295-298.

Luchins, A. S. Proposed methods of studying degrees of rigidity in behavior. *Journal of Personality,* 1946-7, *15,* 242-246.

Luchins, A. S., & Luchins, E. H. New experimental attempts at preventing mechanization in problem solving. *The Journal of General Psychology,* 1950, *42,* 279-297.

Luchins, A. S. The *Einstellung* test of rigidity: its relation to concreteness of thinking. *Journal of Consulting Psychology,* 1951, *15,* 303-310.

Luchins, A. S., & Luchins, E. H. The *Einstellung* phenomenon and effortfulness of task. *The Journal of General Psychology,* 1954, *50,* 15-27.

Luchins, A. S. A variational approach to the role of set in problem solving. *Acta. Psychologica,* 1955, *11,* 215-217.

Luchins, A. S. An instance of mental set: its history and application. In *Experimental Analysis of set.* Moscow: XVIII International Congress of Psychology, 1966. 105-115.

Siegel, S. *Nonparametric Statistics for the Behavioral Sciences.* New York: McGraw-Hill, 1956.

Uznadze, D. N. Eksperimental'nye osnovy psikhologii ustanovki (Experimental basis of the Psychology of set). In A. Prangishvili (Ed.), *Eksperimental'nye Issledovaniia po Psikhologii Ustanovki* (*Experimental Basis of the Psychology of Set*). Tbilisi: Academy of Sciences, 1958. 3-119.

Uznadze, D. N. *Eksperimental'nye Osnovy Psikhologii Ustanovki* (*Experimental Basis of the Psychology of Set*). Tbilisi: Academy of Sciences, 1961.

Uznadze, D. N. *Psikhologicheskie Issledovaniia* (*Psychological Investigations*). Moscow: Academy of Sciences, 1966.

Uznadze, D. N. *The Pschology of Set.* New York: Consultants Bureau, 1966.

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

RICK ODEGAARD
and
DAVE SHAPIRO
Alberta Human Resources Research Council
and
Princeton University, Dept. of Economics

Salary Structure and Education of Alberta Teachers: An Economic Analysis

Salary schedules for teachers in Alberta are presumably structured so as to compensate individuals for the training which they complete. The analysis in this paper, however, indicates that, in terms of the present value of lifetime earnings adjusted for negotiated increases in salaries, the way in which training is acquired is at least as important as how much training is acquired in determining compensation. Financially, it is much more advantageous to acquire training part-time while teaching rather than full-time prior to teaching. In addition, those who acquire all their training full-time appear to be better off financially to stop after four years of university, since further training is not adequately compensated.

In *The Wealth of Nations,* Adam Smith enumerated "five . . . principal circumstances which . . . make up for a small pecuniary gain in some employments, and counter-balance a great one in others." Of these five, the second is of interest here, viz., "the easiness and cheapness, or the difficulty and expense of learning (an employment) (Smith, p. 79)". Thus, according to Smith, the greater the extent of training required for a particular occupation, the higher should be the income associated with performing that occupation.

More generally, differences in the amount of time required for job training may be viewed as requiring compensating differences in income. Empirical studies which have examined the relation between differences in training or education and income have found that in-

come differences do not simply reflect differences in education, but, in fact, they more than compensate for the required investment. (Becker, 1964; Friedman & Kuznets, 1945; Hansen, 1963; Wilkinson, 1966). Hence, "the costs of educational preparation for job training may thus be viewed as an investment in human capital (Friedman, p. 20)."

Applying the concepts above to consideration of salary schedules facing Alberta teachers, we would expect that those teachers with greater training would receive adequately compensatory salaries. However, our analysis leads us to conclude that this is not the case: greater rewards, in terms of lifetime earnings, do *not* necessarily accrue to the teachers with greater preparation.

In addition, the way in which training is acquired also has a considerable impact on lifetime earnings; and it is generally the case that acquiring training (i.e., additional schooling) while on the job is financially more advantageous than acquiring the same training prior to beginning teaching. Hence, there is a dual paradox here: the salary structure bases salary differentiation on differences in educational preparation, and yet lifetime earnings are higher for those with four years of pre-job training as compared to those with five or six years of pre-job training; and while "equal pay for equal preparation" is a cornerstone of the salary structure, the way in which preparation is acquired has a considerable impact on the ultimate amount of earnings.

The bulk of the remainder of this paper will describe the methodology used and the resulting data which prompted us to make the points noted above.

Investment in Training by Teachers

The Training Strategies

There are seventeen educational strategies that may be taken by prospective teachers. They include full-time study only, or full-time plus extension (i.e., summer and night school) study with the assumption that it takes three years of extension work to acquire the five courses necessary for one year of salary credit. This assumption is subject to criticism, of course, in that it is possible to take more or less time depending on the individual and the availability of applicable courses in extension programs.

The strategies are set out in Table 1, with the alphabetized numbers representing fulfillment of the residence requirement in the case of Masters' students. Other than the return to school to fulfill the residence requirement, we have not considered any other strategy involving a return to full-time school attendance. The basic reason for this omission, as the discussion below on opportunity cost will indicate, is that such strategies are sub-optimal—i.e., they are financially less advantageous than the strategies examined which involve simply on-

the-job training. In addition, it would appear that such strategies are not very popular. Data from the "Replication of the Cameron Commission Study of the Alberta Teaching Force" of 1968-69 indicate that only 4.2% of experienced teachers had attended university full-time in the previous year; and given that many of these individuals were fulfilling the residence requirement for a Master's degree, it is clear that the omitted strategies have little empirical significance.

TABLE 1

SEVENTEEN EDUCATIONAL STRATEGIES OPEN TO PROSPECTIVE TEACHERS

Years of Training Acquired Full-Time	Years of Training Acquired While Teaching				Teaching Life N = 40	Strategy
2					N	A
2	3				N	B
2	3	4			N	C
2	3	4	5		N	D
2	3	4	FIVE[a]	6	N	E
2	3	4	5	SIX[a]	N	F
3					N-1	G
3	4				N-1	H
3	4	5			N-1	I
3	4	FIVE[a]	6		N-1	J
3	4	5	SIX[a]		N-1	K
4					N-2	L
4	5				N-2	M
4	5	SIX[a]			N-2	N
5					N-3	O
5	6				N-3	P
6					N-4	Q

[a]Acquired during full-time attendance while completing residence requirement.

Career Length and Opportunity Cost

As indicated in Table 1, we have assumed a career length or teaching life of 40 years. This period applies to those who begin teaching after acquiring two years of training (the minimum training time required for most of the period which we consider). Each additional year of training reduces the career length by one year, since "training takes

time, and each additional year of it postpones the individual's earnings for another year, generally reducing the span of his earning life (Mincer, p. 284)."

Thus, those who remain in school full time beyond the minimum of two years experience an opportunity cost—viz., the earnings which they forego in order to remain in school. For example, an individual who acquires a four-year B.Ed. foregoes two years of earnings. All calculations in this paper, then, have been made on the assumption that the teacher with two years of post-secondary education has a career life of forty years, while those who remain in school forfeit a year of their career for every additional year in school.

Negotiated Increases

All too often, the future earnings of teachers are calculated by simply summing the absolute yearly incomes that are reflected in a current salary schedule. Given that a teaching career spans 40 years for the teacher with two years of university education, the simple summation of lifetime earnings in equation form would be

$$\sum_{j=0}^{39} Y_j = Y_0 + Y_1 + \ldots + Y_{38} + Y_{39} \quad , \quad (1)$$

where Y_j equals the income in the $(j+1)^{th}$ year of teaching (in most cases, all terms beyond Y_{11} will be identical, since they will equal the maximum income associated with the level of training, Y_{max}).

The student who is deciding to complete a B.Ed. would calculate

$$\sum_{j=0}^{37} Y_j = Y_0 + Y_1 + \ldots + Y_{36} + Y_{37} \quad , \quad (2)$$

in order to find the simple summation of his lifetime earnings.

One important consideration which is excluded in these calculations is the average annual negotiated increase in salaries. Given that such increases have occurred and will continue to occur, it seems logical to include them in computations of lifetime earnings.

To do so, we must alter the terms in our previous equations. Assuming a constant annual percentage rate of increase, i, we can see that while the Y_0 term in equation (1) will remain unchanged, the second term will be $Y_1(1+i)$, to reflect the negotiated increase. Similarly, the third term will be $Y_2(1+i)^2$, to reflect the compounding of two years of increases. More generally, the $(n+1)^{th}$ term will be $Y_n(1+i)^n$; and we can reformulate equation (1) to take account of negotiated increases as follows:

$$\sum_{j=o}^{39} Y_j(1+i)^j = Y_0 + Y_1(1+i) + Y_2(1+i)^2 + \ldots + Y_{max}(1+i)^{39} \quad (1')$$

where Y_j is the salary which would prevail in the $(j+1)^{th}$ year of teaching if the current schedule remained in force, and $(1+i)^j$ is the factor by which Y_j is adjusted in order to compute the expected salary for the $(j+1)^{th}$ year of teaching, given that salaries increase at a constant annual percentage rate of i.

The reformulation of equation (2) is slightly more complicated, since the individual who remains in school to complete a B.Ed. will enjoy a starting salary which has undergone two years of increases since the beginning of his maximum career length. Hence, *in terms of this year's salary schedule,* the summation of lifetime earnings for the individual who goes on to complete a B.Ed. will be:

$$\sum_{j=o}^{37} Y_j(1+i)^{j+2} = Y_0(1+i)^2 + Y_1(1+i)^3 + \ldots + Y_{max}(1+i)^{39} \quad (2')$$

More generally, then, we can express the summation of lifetime earnings (taking account of annual increases in salaries) for individuals with n years of training as:

$$\sum_{j=o}^{39-(n-2)} Y_j(1+i)^{j+n-2} = Y_0(1+i)^{n-2} + Y_1(1+i)^{n-1} + Y_2(1+i)^n + \ldots + Y_{max}(1+i)^{39} \quad (3)$$

It is readily seen that for n=2, equation (3) reduces back to equation (1′); and there will be 40 terms reflecting a 40 year career. For each year of training past the minimum requirement of two years, there will be one less term, reflecting the opportunity cost of additional training; but the adjustment factor — $(1+i)^{j+n-2}$ — will still reflect the negotiated increase(s) which took place during the year(s) of foregone earnings.

The Concept of Present Value

In the section above, we made provision for increases in salary schedules over time, in an attempt to make our calculations more realistic. In this section, we introduce a further modification—of a more subtle nature, perhaps—but no less realistic. This modification is use of the concept of *present value,* used here "in the sense in which it is conventionally used in the mathematics of finance: the value at the present time of a sum of money due at a determinable future date—in other words, the value now of a salary which the teacher will receive n years hence." (Friedman, p. 24, fn. 7). In a more pedestrian fashion, "present value" is the value today of tomorrow's income.

If a teacher were paid this year for his next year of teaching, he would be paid an amount slightly less than the full amount since he would be able to invest the income at market rates of interest. If the original amount plus interest earned equalled his next year's salary, then we can say that he was given the present value of next year's income. In order to determine present value, then, we must discount future earnings at market interest rates (discount rate).

Given a discount rate, r, we can express the present value of next year's income as $P.V._1 = \frac{Y_1}{1+r}$ — i.e., the amount of income divided by one plus the discount rate. Assuming a constant discount rate for simplicity, we can see that for any year j years from now, the present value of the income in that year will be the amount of income divided by $(1+r)^j$. Therefore, we can take any income stream, compute the present value of income from each of the career years, and sum these present values to get the present value of lifetime earnings.

Thus, the equation expressing the present value of lifetime earnings can be developed simply by modifying equation (3) to:

$$\sum_{j=o}^{39-(n-2)} \frac{Y_j(1+i)^{j+n-2}}{(1+r)^{j+n-2}} = \frac{Y_0(1+i)^{n-2}}{(1+r)^{n-2}} + \frac{Y_1(1+i)^{n-1}}{(1+r)^{n-1}} + \frac{Y_2(1+i)^{n}}{(1+r)^{n}} + \ldots + \frac{Y_{max}(1+i)^{39}}{(1+r)^{39}}, \quad (4)$$

where again, Y_j is the salary which would prevail in the $(j+1)^{th}$ year of teaching if the current schedule remained in force, i is the annual rate of increase in salaries, n is equal to the number of years of training, and r is the discount rate. Hence, $(1+i)^{j+n-2}$ adjusts Y_j for increases in salary schedules, while the new term, $(1+r)^{j+n-2}$, adjusts Y_j in order to express it in current dollars.

Equation (4) shows quite nicely the effects of differences in training. For example, increased training: 1—results in foregone earnings, by shortening the career length and hence reducing the number of terms in the summation; 2—yields a higher adjustment for salary increases for any given year of teaching; and 3—results in a higher discounting for present value for the same reason as above—i.e., the postponement of earnings. Thus, the first and third effects of increased training tend to make it financially disadvantageous, while the second effect works to make increased training financially advantageous.

Which tendency is stronger is an empirical question, and it is this question to which we now turn.

Results

Equation (4) was applied to the salary schedules of the Edmonton Public School Board from 1959-60 to 1968-69 inclusive. After looking at salary schedules from throughout the province, we felt that the general similarity of salary schedules justified analyzing the schedules of only one district; and we do not think that analyzing schedules of different districts would yield very different results.

Based on the results illustrated in Table 2, we selected 5% as the best approximation for an average negotiated increase. In addition, 3% was used to reflect a possible change in negotiated increases. In conjunction with these two rates of negotiated increase, we used two discount rates—8% and 10%. The lower figure, equal to the current

TABLE 2

AVERAGE ANNUAL PERCENTAGE SALARY INCREASES (1958-69)
IN SELECTED DISTRICTS

Level of Experience	Level of Education (years)		
	2	4	6
	Edmonton Public School District		
Minimum	4.25%	5.97%	5.65%
3 years	4.03	5.61	5.37
6 years	3.85	5.42	5.42
Maximum	3.03	4.41	4.35
	Calgary Public School District		
Minimum	4.59	5.30	
3 years	4.88	5.56	
6 years	5.16	5.95	
Maximum	4.96	5.78	
	County of Athabasca		
Minimum	4.95	5.51	
3 years	4.53	5.06	
6 years	4.74	5.12	
Maximum	5.54	5.76	

market rate on Canada Savings Bonds, may be viewed as representative of a "riskless" investment; while the 10% figure was used since we felt it reflected a return available in markets not entirely risk-free. All four possible combinations of these two sets of rates were computed.

It should be noted that we excluded consideration of a rate of inflation in our computations. This was due to our feeling that inflation would be reflected at least in part by the negotiated increases and the discount rate. In addition, we felt that making four different calculations provided sufficient flexibility and hence generality for our findings; and in this light, then, inclusion of a rate of inflation would unnecessarily complicate the calculations.

Tables 3 and 4 are presented here to summarize our findings. Table 3 is most representative of the four calculations, while Table 4 is the calculation most different from the other three, and is presented for purposes of comparison. Differences in rankings between the two tables are due to the different discount rates used; hence, with the higher discount rate, those strategies for which earnings are relatively high in the later years tend to suffer. Because of the overall similarity of the tables, they will not be discussed separately.

One of the striking features of the tables is the consistency of rankings of strategies over the ten year period. Grouping the rankings into the top six, the middle five, and the bottom six, we find that of the bottom six, five involve no on-the-job training. In other words, in terms of lifetime earnings, all strategies which involve strictly full-time school attendance with no further training are the least desirable.

In addition, examination of the rankings of strategies L, O, and Q reveals that for three of the four computations, L is superior to O which in turn is superior to Q. Thus, given that an individual is going to complete his training prior to beginning teaching, it is generally financially unwise for him to do more than complete a four-year B.Ed., since each additional year of training *lowers* the present value of his lifetime income. This prevails, despite the higher pay for greater training.

Looking at the top six strategies, we find that they all involve on-the-job training. In fact, those strategies involving no on-the-job training are all included in the bottom six, therefore, it is the amount of on-the-job training which determines the rank above those. In the top six, all strategies involve at least two additional years of salary credit, i.e., at least six years of extension study. The top three strategies entail beginning teaching with the minimum requirement of two years and acquiring three or four years of salary credit on-the-job. It is interesting to note that those strategies involving a return to school on a full-time basis in order to complete the residence requirement for a

TABLE 3

RANKINGS OF THE PRESENT VALUE OF LIFETIME EARNINGS FOR THE SEVENTEEN TRAINING STRATEGIES, EDMONTON PUBLIC SCHOOL DISTRICT, 1959-60 THROUGH 1968-69(I)

Training Strategy	Year									
	59-60	60-61	61-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69
A	17	17	17	17	17	17	17	17	17	17
B	15	15	15	15	15	15	15	15	15	15
C	7	7	7	7	7	7	7	7	7	7
D	1	1	1	1	1	1	1	1	1	1
E	2	2	2	2	2	2	2	2	2	2
F	3	3	3	3	3	3	3	3	3	3
G	16	16	16	16	16	16	16	16	16	16
H	11	11	11	11	11	11	11	11	10	9
I	4	4	4	4	4	4	4	4	4	4
J	5	5	5	5	5	5	5	5	5	5
K	6	6	6	6	6	6	6	6	6	6
L	13	12	12	12	12	12	12	12	12	12
M	8	8	8	8	8	8	8	8	8	8
N	10	10	10	10	10	10	10	10	11	11
O	12	13	13	13	13	13	13	13	13	13
P	9	9	9	9	9	9	9	9	9	10
Q	14	14	14	14	14	14	14	14	14	14

Note.-Discount Rate = 10%, Rate of Increase = 5%, 1 = Highest Rank

Masters Degree are consistently in the top six strategies (with the exception of strategy N).

The forfeited year of salary reduces the absolute amount of lifetime earnings, but affects the ranking only slightly in a downward direction. The option of attaining a Masters on a completely part-time

TABLE 4

RANKINGS OF THE PRESENT VALUE OF LIFETIME EARNINGS FOR THE SEVENTEEN TRAINING STRATEGIES, EDMONTON PUBLIC SCHOOL DISTRICT, 1959-60 THROUGH 1968-69(II)

Training Strategy	Year									
	59-60	60-61	61-62	62-63	63-64	64-65	65-66	66-67	67-68	68-69
A	17	17	17	17	17	17	17	17	17	17
B	15	15	15	15	15	15	15	15	15	15
C	8	10	10	10	10	10	10	10	10	8
D	2	2	2	2	2	2	2	2	1	1
E	1	1	1	1	1	1	1	1	2	2
F	3	3	3	3	3	3	3	3	3	3
G	16	16	16	16	16	16	16	16	16	16
H	11	11	11	11	11	11	11	11	11	11
I	6	6	6	6	6	5	5	5	5	4
J	4	4	4	4	4	4	4	4	4	5
K	5	5	5	5	5	6	6	6	6	6
L	14	14	14	14	14	14	14	14	14	14
M	10	9	9	9	9	9	9	9	9	9
N	9	8	8	8	8	8	8	8	8	10
O	13	13	13	13	13	13	13	13	13	12
P	7	7	7	7	7	7	7	7	7	7
Q	12	12	12	12	12	12	12	12	12	13

Note.-Discount Rate = 8%, Rate of Increase = 5%, 1 = Highest Rank

basis has just become available and warrants discussion. Our equation for determining lifetime earnings was applied to such strategies, with predictable results. Table 5 below indicates the absolute amounts and rankings of the 1968-69 Edmonton Public schedule including the three additional Master's strategies previously mentioned.

TABLE 5

PRESENT VALUE OF LIFETIME EARNINGS OF TEACHERS IN EDMONTON PUBLIC SCHOOL DISTRICT, 1968-69

Strategy										$ Amount	Rank
Full-Time	Part-Time										
2										114,382	20
2	3									125,095	18
2	3	4								161,202	10
2	3	4	5							166,266	3
2	3	4	5[a]	6						163,873	5
2	3	4	5	6[a]						163,791	6
2	3	4	5	6[b]						170,393	1
3										120,100	19
3	4									157,993	12
3	4	5								163,658	7
3	4	5[a]	6							161,516	8
3	4	5	6[a]							161,299	9
3	4	5	6[b]							168,383	2
4										152,731	15
4	5									159,101	11
4	5	6[a]								156,939	14
4	5	6[b]								164,438	4
5										151,298	16
5	6									157,307	13
6										149,463	17

Note-Discount Rate = 10%, Rate of Increase = 5%

[a] Year of residence requirement

[b] Without residence requirement

With or without a residence requirement, the brunt of our argument is aptly illustrated by the statistics. The best lifetime income accrues to those teachers who leave school as soon as possible and acquire further training while teaching. As a corollary to this, we may add that for any given level of training, it is financially least advantageous to aquire all the training full-time, and most advantageous to acquire the minimum training full-time, and the rest part-time while teaching.

Hence, in terms of the present value of lifetime earnings, "equal pay for equal training" does not exist.

As supporting evidence, we present Table 6, which gives the training of beginning teachers and of all teachers in the Alberta teaching force of 1968-69. Excluding consideration of teachers with less than two years of training, it is seen that beginning teachers are in disproportionately greater numbers at the lower levels of training (two, three, and four years), and vice-versa. This is in accord with our expectations derived from the analysis above. In particular, the high proportion of beginning teachers with the minimum training of two years and the low proportion with more than four years of training is noteworthy; since in conjunction with the proportions for all teachers, it suggests that a fair number of teachers do indeed begin teaching with the minimum requirements and then take extension courses to increase their level of training.

TABLE 6

TRAINING OF BEGINNING TEACHERS AND OF ALL TEACHERS IN ALBERTA, 1968-69

Years of Training	Beginning Teachers	All Teachers
1 or less	1.4%	17.5%
2	30.8	19.7
3	16.4	11.9
4	40.9	31.0
5	8.5	11.9
6 or more	2.0	8.1

Note.- Source of data: A.A.C.E.S. Study of the Alberta Teaching Force, 1968-69. (See: Ratsoy, E. W. Characteristics and instructional practices of Alberta Teachers in 1968-1969. Edmonton: The Alberta Advisory Committee on Educational Studies, 1970.)

There are a few points, some of a mitigating nature, which should be made here; and they may conveniently be viewed as benefits or costs not noted above. To the extent that university education is regarded as a consumption good, it is misleading to refer to it as if it were solely an investment—i.e., individuals may remain in school beyond the minimum required because they like it, and the consequent decrease in present value of lifetime income may be more than outweighed by the utility attached to further schooling. However, it should also be noted that we did not consider the *cost* of extra schooling, and for individuals who get all of their training full-time, inclusion of cost considerations would further widen the differentials.

In addition, we made no mention earlier of the costs—financial

or psychic—of on-the-job training. As well as the financial cost of extension training, there is also a psychic cost related to giving up of leisure time and/or the option to pursue additional employment. Consideration of these costs serves to mitigate our earlier conclusions, since they decrease somewhat the desirability of the financially advantageous training strategies. We did not, however, consider the payments for fractions of years of salary credit which are made by many boards throughout the province. Since these payments add to the lifetime earnings of those who pursue schooling while on the job, but do not affect the earnings of others, their inclusion would further widen the differentials discussed above.

Also, it has been suggested that those teachers who spend five or six years in full-time school attendance are the teachers with the greatest chance of advancing quickly into administrative positions. While this is important, it does not alter our conclusions with regard to the vast majority of teachers who remain in teaching positions.

Conclusions

Our analysis has led us to the conclusion that it is financially most advantageous to begin teaching as soon as possible. Hence, it follows that many of those teachers who remain in school on a full-time basis are not being adequately compensated, and indeed, many experience a real loss of income. In addition, it is clear that lifetime income depends not so much on *how much* training is acquired, but on *how* training is acquired.

We find these conclusions to be somewhat paradoxical in a system which purports to increasingly reward increasing education and to equally reward equal education.

Post-script

The general conclusion from above most relevant to school boards would seem to be as follows: salaries for teachers with greater levels of training should be raised relative to salaries for teachers with lesser levels of training. This conclusion, however, rests on a very critical assumption; and it is this assumption which we would like to make explicit and briefly discuss in this post-script.

The assumption in question is the first of the two assumptions which provide the basis for the structuring of salary schedules—viz., that more training means better teaching. (The second assumption being that more experience means better teaching.) Our failure to comment earlier on the relationship between training and quality of teaching may have been interpreted as a tacit assumption that there is indeed a close

and positive correlation between the two; and it is this notion which we would like to dispel.

That is, salary schedules assume that more training means better teaching; we do not make that assumption. We are unaware of evidence which either supports or rejects the assumption; hence, we consider it as an open question. The signficance of the assumption should be clear by now, however: the general conclusion noted above is meaningful and relevant only if the assumption that more training means better teaching is correct.

In addition, it should be noted that we analysed only those training strategies which were *financially* most advantageous (see comments on *The Training Strategies,* pp. 228-9. It is quite possible that the omitted strategies, involving a variety of combinations of full-time school attendance and full-time teaching, might include ones which were better than the analysed strategies in terms of developing the "best" teachers.

In conclusion, therefore, given that high quality of education is a major goal of educators, we suggest that considerable study be done in attempting to ascertain the factors responsible for the making of a good teacher; and then, remuneration of teachers should be structured so as to financially encourage those training strategies which produce the best teachers.

References

Becker, G. S. *Human Capital.* New York: National Bureau of Economic Research, 1964.

Friedman, C. H. Education of New York City public school teachers: an economic analysis. *Industrial and Labor Relations Review,* 1964, *18,* 20-31.

Friedman, M., & Kuznets, S. *Income from Independent Professional Practice.* New York: National Bureau of Economic Research, 1945.

Hansen, L. Total and private returns to investment in schooling. *Journal of Political Economy,* 1963, *71,* 128-140.

Mincer, J. Investment in human capital and personal income distribution. *Journal of Political Economy,* 1958, *66,* 281-302.

Smith, A. *The Wealth of Nations.* Homewood, Illinois: Richard D. Irwin, Inc., 1963.

Wilkinson, B. Present values of lifetime earnings for different occupations. *Journal of Political Economy,* 1966, *74,* 556-572.

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

HELEN L. PIERCE
The University of Alberta

Changes in the Elementary and Junior High School Ecology in an Urban School District

This is a longitudinal study of changes from 1962 to 1969 in the ecology of elementary and junior high school pupil personnel in a small urban school district. Ecological mapping is the method used to study changes in distance pupils journey to school, in concentration of pupils, and in distribution of pupils. These changes seem to be associated with changes in the location of schools. Four ecological processes are identified in the study. Further research is required to ascertain whether changes in school locations is a cause or consequence of the changes observed. Moreover, if this ecological study is to be complete, research that includes high school pupil personnel is necessary.

Competition for space is one of the fundamental social processes in all communities; the schools and their spatial patterns are a part of this competitive process. The consequence of the process is an ecological patterning which involves schools. The ecology of the school district is, therefore, a conscious or sub-conscious concern of pupils, parents, school and city administrators, and school boards as well as other individuals in a community. One aspect of school ecology is the distance children live from school—an important factor in Western Canada with its extreme climatic conditions. Motor vehicles have reduced our concern about space relations in some instances but they have not eliminated the effect of distance for many people living in a school district. Competition for space which is convenient to schools is a factor in the migration of population within a school system. Then, a basic aspect of education today would seem to be the ecological patterns associated with schools in a community or school district.

Some brief comments on ecology elaborate the above point of view. When the basic competitive process is analyzed, six sub-processes come into view. Briefly, they are *concentration*, gathering of population in

an area; *centralization,* the drawing together of institutions for people to work; *sub-centralization,* centralizing at more than one location; *segregation,* grouping of similar types of people or specific functions in an area; *invasion,* moving to an area by institutions or population groups; and *succession,* ceding of space to the invaders (Lundberg, *et al.,* 1968, pp. 128-134). In this study these processes provide a conceptual framework for examining the overall ecology of schools in a specific community. One of the advantages of an ecological study of social processes is the knowledge it provides of social change over time.

Problem

This is a report of a longitudinal study of some changes that occurred in the elementary and junior high school ecology of an urban school district during the seven-year period from 1962 to 1969. In May 1962, the investigator began an ecological study of schools in a small city (Pierce, 1964). One of the school systems examined was a separate school district with one school building serving elementary, junior high, and senior high school pupils (Schools A). However, another school site had been purchased by the district and a second elementary school was opened in the fall of 1962 (School B). In May 1969, the distribution of elementary, opportunity, and junior high school classes was obtained from the same school district. (In this study, children in opportunity classes are treated as elementary school pupils.) Thus, with the two sets of data, it became possible to do a longitudinal, ecological study in the small city.

Four questions were asked:

1. What were the changes in the distance pupils journeyed to school?
2. What were the changes in concentration of pupils near school sites?
3. What were the changes in distribution of pupils in city areas?
4. What ecological processes do these changes represent?

Method

Ecological mapping was the method used in this study. In both 1962 and 1969, addresses of enrolled elementary and junior high school pupils were supplied by school principals. These addresses were then plotted on maps. Distance from school was estimated by means of concentric circles radiating from the schools with each circle representing an increased distance of one-quarter mile. The city was divided into six natural areas based on physical characteristics and road patterns primarily.

Tables were used to summarize map data. The actual distribution, derived from the plotted addresses on the maps and converted to

percentages, was used to categorize pupils by distance from school and by residence in six natural areas. From distribution percentages the concentration index in zones—areas bounded by concentric circles as shown on the maps—was established. In addition, plotted addresses were used to determine the percentage change in pupil distribution in natural areas.

Results

What were the changes in the distance pupils journeyed to school? It could be hypothesized that with two schools in the small city compared with one the distances journeyed to school would be considerably reduced. As shown in Table I and illustrated on Maps 1 to 5, the most striking reduction was with elementary school pupils living within one-quarter mile and one-quarter to one-half mile of school in 1969 as compared with 1962. However, in 1969 at School B a higher percentage of pupils journeyed three-quarters to one mile to school than in 1962 at School A. At the junior high school level, marked reduction in distance journeyed is noted in the one-half to three-quarters mile and three-quarters to one mile zones. There was a striking increase, however, in the percentage of pupils that journeyed from one to one and three-quarters mile to school. It can be concluded, then, that with two rather than one school, at the elementary school level a higher

TABLE 1

DISTRIBUTION IN PERCENTAGE OF PUPIL PERSONNEL BY DISTANCE FROM SCHOOL, 1962 AND 1969

Distance in Miles	Elementary Schools			Junior High School	
	1962 A	1969 A	1969 B	1962 A	1969 A
0 to 1/4	25%	36%	38%	27%	26%
1/4 to 1/2	18	22	24	15	18
1/2 to 3/4	29	20	16	32	16
3/4 to 1	12	2	16	12	8
1 to 1 1/4	2	5	4	3	7
1 1/4 to 1 1/2	1	1	1	0	8
1 1/2 to 1 3/4	0	0	0	0	6
Rural	13	14	0	12	10
No Address	0	1	0	0	0
N	234	197	135	101	148

Map 1. Distribution of elementary school pupil personnel at school A, 1962. The radii of the concentric circles increase by a distance representing one-quarter mile. Each dot represents one pupil.

Map 2. Distribution of elementary school pupil personnel at school A, 1969. The radii of the concentric circles increase by a distance representing one-quarter mile. Each dot represents one pupil.

Map 3. Distribution of elementary school pupil personnel at school B, 1969 The radii of the concentric circles increase by a distance representing one-quarter mile. Each dot represents one pupil.

Map 4. Distribution of junior high school pupil personnel at school A, 1962. The radii of the concentric circles increase by a distance representing one-quarter mile. Each dot represents one pupil.

Map 5. Distribution of Junior High School pupil personnel at School A, 1969. The radii of the concentric circles increase by a distance representing one-quarter mile. Each dot represents one pupil.

Map 6. Natural areas.

percentage of pupils journeyed shorter distances to school while at the junior high school level a considerably higher percentage of pupils travelled more than one mile to school.

What were the changes in concentration of pupils near school sites? It seemed that with two school sites there would be concentration of pupils around each school. To determine the concentration index, the estimated occupied space in each zone was determined from Maps 1 to 5 and the actual distribution of the pupils was taken from Table 1. (Zones are indicated by the concentric circles with the school located in Zone 1.) The degree of concentration of pupil personnel is shown in Table 2 for School A in 1962 and 1969 and for School B in 1969.

TABLE 2

PUPIL CONCENTRATION IN RELATION TO SCHOOL ATTENDED

School	Zone	Occupied Area a	Distribution		Concentration Index d
			Theoretical b	Actual c	
A Elem.	1	.50	8%	25%	3.13
1962	2	1.50	23	18	.78
	3	1.67	26	29	1.12
	4	1.75	27	12	.44
		5.42		84	
A Elem.	1	.70	13	36	2.77
1969	2	1.50	29	22	.76
	3	1.50	29	20	.69
	4	.50	10	2	.20
		4.20		80	
A Junior	1	.67	11	27	2.45
High	2	1.00	17	15	.88
1962	3	1.67	28	32	1.14
	4	1.75	30	12	.40
		5.09		86	
A Junior	1	.50	8	26	3.25
High	2	1.00	15	18	1.20
1969	3	1.60	25	16	.64
	4	1.67	26	8	.31
	5	.50	8	7	.88
	6	.25	4	8	2.00
	7	.25	4	6	1.50
		5.77		89	
B Elem.	1	.60	11	38	3.45
1969	2	.70	12	24	2.00
	3	2.00	35	16	.46
	4	2.00	35	16	.46
		5.30		94	

Note.-The following is a guide to reading the table:

a--Occupied area: (estimated)

b--Theoretical distribution:

$$\frac{\text{Occupied area in Zone}}{\text{Total occupied area}} \times \text{total actual distribution}$$

c--Actual distribution: See Table 1

d--Concentration index: $\frac{\text{Actual distribution}}{\text{Theoretical distribution}}$

Concentration: >1

Dispersion: <1

The indices suggest that while there was concentration of pupil personnel around elementary school sites, it was more noticeable when there were two schools. Junior high school pupil concentration areas changed from one near and one somewhat removed from School A to one adjacent to School A and one at Zones 6 and 7 in the vicinity of School B.

What were the changes in distribution of pupils in city areas? To further study the changes, the percentages of pupils living in natural areas (space marked off by traffic arteries and natural boundaries) for the two periods are given in Tables 3 and 4. These data were obtained from pupil distribution as plotted on Maps 1 to 3 and Maps 4 and 5. Map 6 shows the natural areas I to VI.

By comparing the percentages for 1962 and the 1969 total column in Table 3, some changes are evident. In Area I, little percentage difference is noted. However, the percentage of the total elementary school population in Areas II, III, and IV was decreased for each area. In Area V, there was an increase from 6 percent to 29 percent. These percentages indicate that there was a change in distribution of elementary school pupil personnel, that a much higher per cent of the pupils was living in Area V where School B is located. However, there was not a withdrawal of pupils from Area I, the site of the first school.

TABLE 3

ELEMENTARY SCHOOL PUPIL DISTRIBUTION BY NATURAL AREAS IN 1962 AND 1969

Area	School A				School B		Total	
	1962		1969		1969		1969	
	N	%	N	%	N	%	N	%
I	84	36	122	62	5	4	127	38
II	49	21	15	8	13	10	28	8
III	35	15	15	8	11	8	26	8
IV	19	8	4	2	7	5	11	3
V	14	6	8	4	89	66	97	29
VI	2	1	4	2	10	7	14	4
Rural	31	13	29	15	0	0	29	9
Totals	234		197		135		332	

The changes in junior high school pupil distribution are shown in Table 4. In Area I, where the junior high school is located, the percentage of pupils was increased. However, in Areas II and III there was marked decrease in the percentages. The most noticeable change was in Area V with an increase from 5 per cent to 22 per cent.

TABLE 4

JUNIOR HIGH SCHOOL PUPIL DISTRIBUTION BY NATURAL AREAS IN 1962 AND 1969

Area	1962		1969	
	N	%	N	%
I	37	37	60	41
II	24	24	15	10
III	15	15	14	10
IV	5	5	6	4
V	5	5	32	22
VI	3	3	6	4
Rural	12	12	15	10
Totals	101		148	

To understand more fully the significance of the changes in pupil distribution, it seemed advisable to look at the change in the number of pupils residing in each of the natural areas. By taking 1962 residential distribution in each area as 100 per cent, the percentage change was determined and is indicated in Table 5 for elementary schools and for combined data of elementary and junior high schools. Areas I, V, and VI show growth while the other areas show decline in the number of pupils resident there. Growth was particularly significant in Areas V and VI.

Briefly, one can say that in Area I there was a slight increase, in Areas II, III, and IV there was considerable decrease, and in Area V there was a very marked increase in the percentage of pupils residing there. In Areas I and V there was striking increase and in Areas II, III, and IV there was considerable decrease in the actual number of pupil residents. While there was a seven-fold increase in Area VI, the number of pupils in 1969 was only fourteen.

What ecological processes do these changes represent? The specialized forms of the competitive process of ecology are applied here to analyze the changes in pupil distribution in the school district. Initially, there was concentration of separate school pupils in the urban centre. In 1957 centralization of these pupils occurred when School A was opened. With the growth of the school population, Area V was invaded for a new school site. When School B began operation in the fall of 1962, sub-centralization occurred. The concentration of pupils in Areas I and V and the withdrawal of pupils from Areas II, III, and IV by 1969 suggest the possibility of some segregation in Areas I and V for separate school supporters. (Actually, this does not seem to be the case since one public school is located in Area I and two are situated in Area V.) However, the change does suggest invasion of Area V, early stages of invasion in Area VI, and continued invasion of Area I.

TABLE 5

PUPIL DISTRIBUTION BY NATURAL AREAS AND PERCENTAGE CHANGE, 1962-1969

Area	Elementary School			Elementary and Junior High School		
	1962 N	1969 N	Percent Change	1962 N	1969 N	Percent Change
I	84	127	+151%	121	187	+155%
II	49	28	- 57	73	43	- 59
III	35	26	- 74	50	40	- 80
IV	19	11	- 58	24	17	- 71
V	14	97	+693	19	129	+679
VI	2	14	+700	5	20	+400
Rural	31	29	+ 93	43	44	+102
Totals	234	332	+142%	335	480	+143%

Discussion

Building a second separate school in a small city seems to be associated with changes of pupil distribution during the seven-year period examined in this longitudinal study. With two school sites rather than one, a higher percentage of elementary school pupils tends to journey shorter distances while a higher percentage of junior high school pupils journeys distances to school in excess of one mile. Concentration of elementary and junior high school pupils around school sites is more notice-

able with two schools. Migration of separate school supporters in the city seems to be to the natural areas where the schools are located. Ecological processes of concentration, centralization, sub-centralization, and invasion seem to be evident in the changes observed. Distribution of separate school patrons appears to be changing. Further research is required to determine whether the building of the school is a cause or consequence of the change.

This longitudinal study of changes in the ecology of the separate school pupil personnel is incomplete. No mention was made of the distribution of high school pupils. It is known that during the 1962 to 1969 interval the separate school district closed its high school classes in School A and the pupils attended classes at the composite high school of the public school district in Area V. Further research which would include a study of high school pupil distribution should be undertaken if the ecological study of the separate school district is to be complete.

References

Lundberg, G. A., Catton Jr., W. R., Larsen, O. N., & Schragg, C. C. *Sociology*. New York: Harper & Row, Publishers, 1968, 128-134.

Pierce, H. L. An ecological analysis of the schools in a small Western Canadian city: Camrose, Alberta. Unpublished Master of Education thesis, The University of Alberta, Edmonton, Alberta, 1964.

The Alberta Journal of Educational Research
Vol. XVI, No. 4, December, 1970

DONALD L. PETERS
and
VICTOR MESSIER
The Pennsylvania State University

The Effects of Question Sequence Upon Objective Test Performance[1]

The order of items on a series of four classroom multiple choice tests was manipulated to provide two forms. One form corresponded to the order of classroom presentation of the material, the second represented a randomization of the same items. Little evidence was found to support any overall differences between the two forms. However, experience with one or the other form was found to significantly effect performance in subsequent testing situations. The results were explained in terms of mathemagenic behaviors of students, particularly the inhibiting effect of the randomized version on the learning of the extrinsic structure of the material. Individual differences between students were studied as possible factors affecting responses to the two test forms. Interactions were found between the treatments for the regression of the criteria scores on debilitating anxiety, pretest, intolerance for ambiguity, and dogmatism.

One of the concerns of teachers when constructing objective classroom tests is, "How shall the items be ordered?" A typical answer provided by standard texts on the subject is, "The order in which test items are arranged in the final form of the test is not critical." (Ebel, 1965, p. 157) It has been suggested (1) that early items be made less difficult in an attempt to alleviate anxiety, or (2) that the order of items follow the structure of the material as presented by the teacher. When the latter alternative is selected, there is the possibility of inter-item cuing, which might enhance performance through organizational facilitation of memory and recognition of material in context.

However, the sequence in which course content is presented frequently reflects an externally imposed (though not arbitrary))organization of the material. This extrinsic organization has pedagogical purpose in that it accommodates the constraints of the instructional

[1] This research was supported by the Advanced Research Projects Agency (ONR-ARPA Order No. 1269).

sysem, but it is of secondary importance to utilization of the learned material by the student. Rothkopf (1968) has proposed that task relevant behaviors such as effort, inspection, search, and review, by engaging the student in active processing of information, facilitate acquisition and achievement. Task irrelevant behaviors, such as focusing on the sequence of presentation, rather than on the core of the presented material, may hinder or potentially hinder learning. Accordingly, instructional procedures which increase task relevant processing and minimize task-irrelevant processing behaviors should lead to maximized understanding of the material.

Frase (1968a,b,c) indicates that the events that occur just before the learner is exposed to new material can strongly influence what is learned. He found that pre-test questions act as directive influences and help to establish cues for the learner in deciding what is to be learned. These lead to increased vigilance on the part of the learner and a modification of study habits.

This suggests that test questions which parallel the pedagogical ordering of the material may serve to focus attention on this irrelevant dimension of the material, and hence may be dysfunctional for the subsequent learning of new material where performance is measured in situations where the extrinsic ordering is not maintained. Conversely, testing sequences which deemphasize the extrinsic organization may serve to make the learner more vigilant towards the intrinsic organization of the new material, or force him to more actively process the material to provide his own organization. This activity should facilitate recall or recognition of the information in subsequent testing situations, no matter what organization they represent.

Further, recent research (for example Alpert & Haber, 1960; Ehrlich & Lee, 1969; Fillenbaum & Jackman, 1961) suggests that it is unlikely that all students will respond equally well to different testing situations or attempts to break away from the instructionally provided organizational set. Individual differences in test anxiety level, rigidity for holding beliefs, intolerance for ambiguous situations, and internal-external locus of control seem likely to influence the acceptance and effect of variations in the order of test questions.

The above lines of reasoning suggest two additional considerations when inquiring into the effects of test order. Not only should the test constructor be concerned with whether one test question order is less difficult than another over all, he should also focus on the question, "For which students is one test order easier or more difficult?" Secondly, he should ask, "What value does a particular test organization have for subsequent learning and performance?" These are the questions addressed by the present research.

Methods

Subjects

The subjects were 41 graduate students enrolled in a basic research methods course; 12 were males. They represented a variety of academic fields with the majority pursuing studies in Child Development and Family Relations.

Course

The research was conducted utilizing an existing course and the enrolled students. The course content was research methodology and it was divided into four major topic areas: (1) the philosophy, language, and approach of science; (2) statistical methods; (3) measurement; and (4) research design. Each of the topics represented approximately equal portions of the ten week course.

Measures

A 76-item, four-alternative multiple choice examination was given during the second class meeting as part of the normal procedures for the course. Its purpose was to assess the initial level of competence of the students and to select out those students for whom a more advanced course would be appropriate. (Four students were eliminated on this basis.)

Twenty item, four-alternative multiple choice quizzes followed each of the first three sections of the course, and a sixty-item multiple choice final examination, covering the entire content of the course, followed section 4.

All pretest items, and the majority of the quiz items had been previously used and were found to be good items in terms of discrimination and difficulty level. Internal consistency reliabilities were found to be acceptable for each test.

In addition, as part of the introduction to the measurement section of the course, a short test battery was administered. This battery included: (1) the Internal-External Scale (Rotter, 1966); the Achievement Anxiety Scale (Alpert & Haber, 1960) which yields scores for facilitating and debilitating anxiety; the Dogmatism Scale, Form E (Rokeach, 1960); and the Intolerance for Ambiguity Scale (Budner, 1963). These scores for each student were recorded and the tests were discussed during subsequent class periods.

Procedure

Each of the three quizzes and the final examination were organized in two ways. The same questions appeared on both versions. One form was organized so that the questions followed the *sequential* ordering of the course material as it was presented in class. The other form

was a randomized version of the first. The two forms were randomly distributed to the students at the beginning of each test period.

At the end of the course the students were questioned to determine if they had been aware of the experimental manipulations. It was apparent that none were aware of the actual intent of the study.

Results

It was hypothesized that the sequentially ordered versions of the tests would prove less difficult than the randomized versions in all cases. This was tested by one-tailed t tests. Only the results for Quiz 2 were found to be consistent with the hypothesis ($t=1.89$, $df=39$, $p<.05$). The results for Quizzes 1 & 3 were in the same direction but did not reach an acceptable level of significance. The means and standard deviations for each testing are presented in Table 1.

TABLE 1

ANALYSIS OF EFFECTS OF THE TWO TEST FORMS

Form		Quiz 1	Quiz 2	Quiz 3	Final
Sequential	$\bar{X}$	15.52	15.95	14.85	42.91
	s	2.27	1.94	2.48	5.74
	n	20	23	20	21
Random	$\bar{X}$	14.80	14.50	14.33	43.20
	s	2.40	2.88	2.06	5.64
	n	21	18	21	20

It was also hypothesized that the form taken on a prior test would ultimately effect the performance on a subsequent test through modification of the student's study habits. Testing experiences which de-emphasize the extrinsic, teacher provided, organization of the material (randomized form) were thought to facilitate recall of the information in subsequent testing situations no matter what organization they represented. Hence, it was predicted that students having a random form on the prior test would do equally well on either form in a subsequent test situation. Students having the sequential form on the prior test were predicted to perform less well when this was followed by a random form test than when followed by another sequential form test.

To test these hypotheses, the sample was divided into four groups for each pair of testings. That is, they were divided as to the form of the prior test and the subsequent test. The results of the analysis are presented in Table 2.

TABLE 2

EFFECTS OF PRIOR TEST FORM ON SUBSEQUENT TEST PERFORMANCE

Quiz 1 Form	Quiz 2 Form				
	Sequential		Random		
	$\bar{X}$	s	$\bar{X}$	s	t
Sequential	16.53	1.60	14.29	2.00	2.58*
					df=18
Random	15.20	2.00	14.8	2.66	n.s.
Quiz 2 Form	**Quiz 3 Form**				
	Sequential		Random		
	$\bar{X}$	s	$\bar{X}$	s	t
Sequential	16.33	1.60	14.40	1.82	2.25*
					df=21
Random	14.36	1.82	15.33	2.50	n.s.
Quiz 3 Form	**Final Examination Form**				
	Sequential		Random		
	$\bar{X}$	s	$\bar{X}$	s	t
Sequential	42.80	4.40	49.50	4.33	2.80*
					df=19
Random	42.91	5.66	41.98	4.91	n.s.

*P<.05

It can be seen from Table 2 that students who had the sequential form of the test showed differential performance on the two forms during the next testing. By contrast, the students taking the randomized form were not differentiated in their performance on the two test forms on the subsequent testing. In the cases of Quiz 2 and 3, the results obtained were as predicted, with persons having a sequential prior test performing less well on a subsequent random form. In the case of the final examination, the results indicate superior performance on the random form of the subsequent test.

It was suggested that individuals with different aptitudes would respond differentially to the treatments imposed. The distribution of aptitude variables and their relations to the criteria are presented in Table 3. Significant relationships were found between at least one of the criteria and dogmatism, debilitating and facilitating anxiety, and pretest scores.

TABLE 3

DISTRIBUTION OF APTITUDE VARIABLES AND THEIR CORRELATION WITH THE CRITERIA: TOTAL SAMPLE (N = 41)

Variable	$\bar{X}$	s	Quiz 1	Quiz 2	Quiz 3	Final
Locus of Cont.	9.56	5.19	-.06	-.03	-.02	-.04
Tol. Ambiguity	50.32	7.63	-.05	-.03	-.10	-.03
Dog.	129.83	22.64	-.11	-.18	-.28*	-.25
Deb. Anx.	26.32	6.14	.04	-.40**	-.26*	-.35**
Fac. Anx.	24.95	4.65	.04	.33**	.16	.23
Pretest	39.98	8.56	.30*	.58**	.42**	.53**

*P<.05 (One-tailed)

**P<.01 (One-tailed)

To analyze the interaction of the aptitude measures and the treatment (test forms) effects, the linear regression of each of the criteria measures on each of the aptitude measures was computed separately by treatment. Comparison was then made to determine if the slopes of the regression lines varied significantly by treatment for each aptitude and criterion pair. Four of these were found to be or approach significance. They are summarized in Table 4.

Figure 1 graphically displays the first interaction summarized in the Table. The interaction suggests that persons scoring high on debilitating anxiety perform less well on tests that have the questions in random order than they do on tests that follow the sequential order of instruction. The opposite is suggested for people scoring very low on debilitating anxiety.

It should be noted that the sample mean on debilitating anxiety was 26.32 and, although the axes of Figure 1 represent the actual range of scores obtained, only two scores actually fell below the intersection of the two regression lines. This suggests that if an educational decision concerning the administration of tests to students was to be made, the best choice would be to administer the sequential form of the test to all students.

TABLE 4

REGRESSION EQUATIONS OF MAJOR INTERACTIONS
WITH TEST FORM

Test Form	Criteria	Aptitude	Intercept	Reg. Coef.	df	F
Sequential	Q2	Deb. Anx.	18.36	-.09		
Random			21.98	-.29	1.37	2.90*
Sequential	Q2	Pretest	13.24	.07		
Random			2.29	.30	1.37	14.84***
Sequential	Final	TOA	62.68	-.40	1.37	8.89***
Random			29.91	.26		
Sequential	Final	Dog.	58.03	-.11	1.37	4.44**
Random			35.55	.06		

*P<.10
**P<.05
***P<.01

A highly significant interaction between the regression lines for the two treatments was found when the Quiz 2 scores were regressed on the pretest scores. (Figure 2) Subjects performing low on the pretest performed better on the sequential version of the test than on the random, and subjects scoring high on the pretest scored better on the random form than on the sequential form.

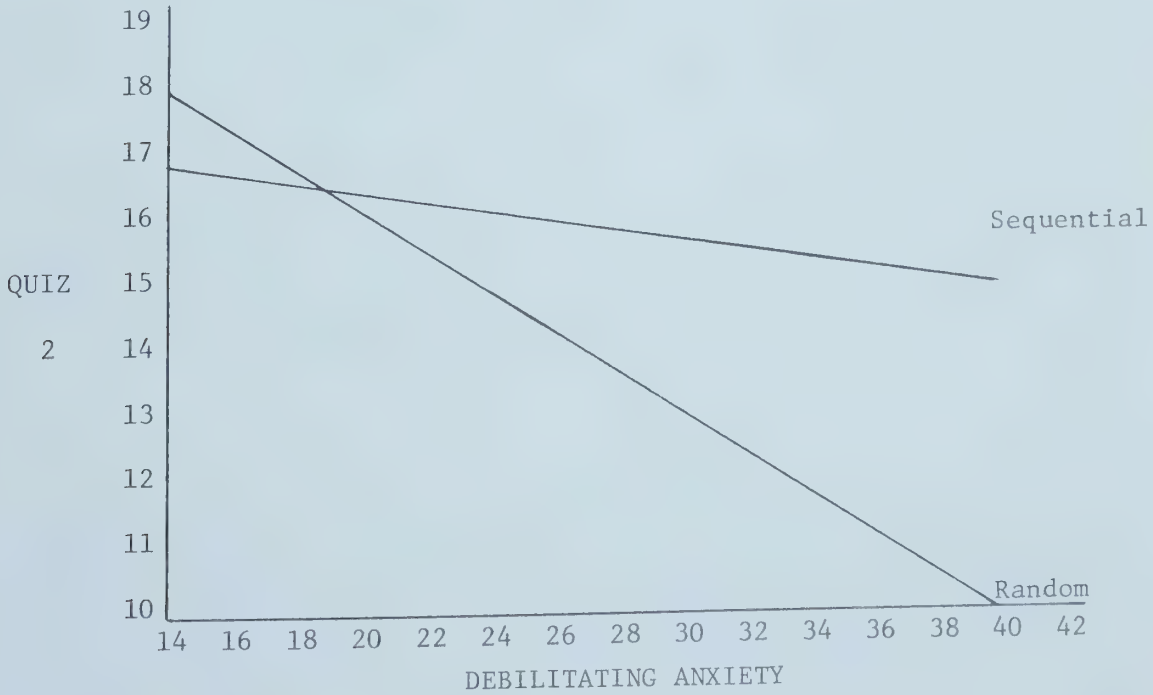

FIGURE 1

REGRESSION OF QUIZ TWO SCORES ON DEBILITATING ANXIETY

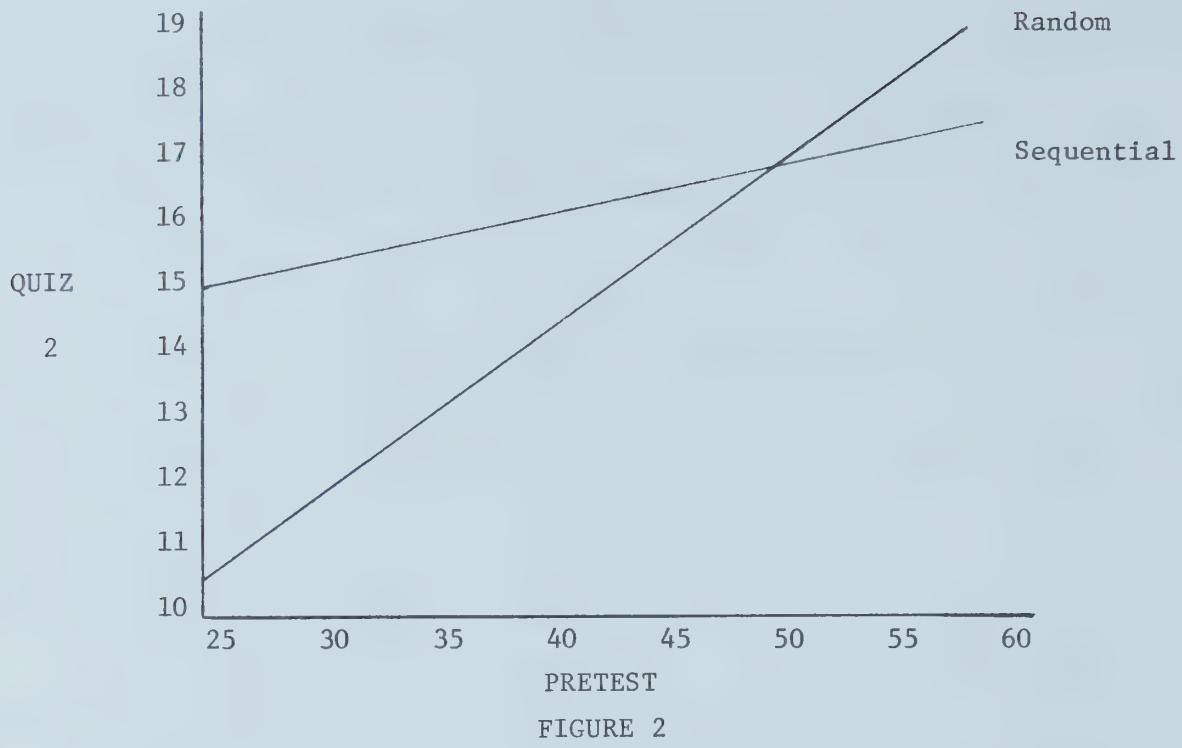

FIGURE 2

REGRESSION OF QUIZ TWO SCORES ON PRETEST SCORES

Figure 3 represents the regression of the final examination scores on the scores for intolerance for ambiguity. This is a clearly disordinal interaction with the intersection of the two regression lines occurring at approximately the mean of both variables. This interaction indicates that those subjects who were intolerant of ambiguity performed better on the random version of the test, while those scoring low performed better on the sequential form of the test. The interaction is counter to the direction expected.

Inspection of Figure 4 again reveals a disordinal interaction that is counter to expectations. It may be interpreted as indicating those who score high on the dogmatism scale perform better on the random form of the test than they did on the sequential form. Conversely, those scoring low on the dogmatism scale performed better on the sequential form than they did on the random form.

Discussion

The results of this study indicate that if the constructor of a classroom test is concerned only with whether ordering test items randomly or parallel to instruction makes a difference in overall test performance, the most reasonable answer is, "No, it does not." Only one of the four comparisons testing this effect was significant at the .05 level.

However, the results contradict the conclusion that the order in which test items are arranged is not critical. Such a conclusion is an

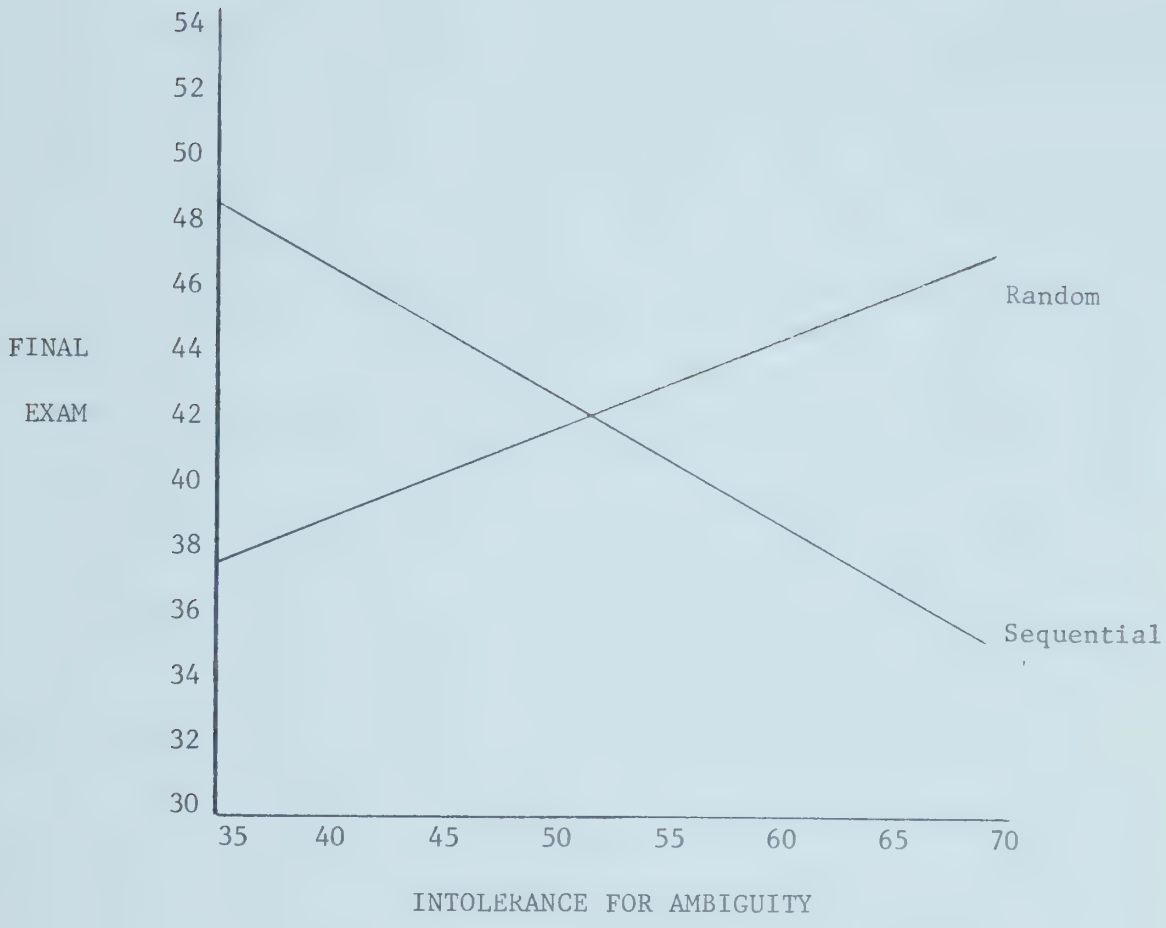

FIGURE 3
REGRESSION OF FINAL EXAM SCORES ON INTOLERANCE FOR AMBIGUITY

over simplification which does not take into account the possible utility of the test for directing subsequent learning. Further, it does not take into account the possibility that the arrangement of the questions on a test may be critical for some individuals.

The data presented in Table 2 strongly suggest that the form of the test that the person experiences, in an actual classroom situation, effects in some way his subsequent learning of new material and/or his performance on subsequent tests. Exactly how test experience affects performance is not clear from this research. However, the data are consistent with the notion that the test serves to increase the task-relevant information processing of the student or to inhibit task-irrelevant processing, or both. Frase (1968) has suggested that pre-questions serve as cues to identify relevant content for study, and that this is accompanied by inhibition of responses to incidental stimuli. More recently, Frase, Patrick, & Schumer (1970) have reported that the negative consequences of such stimuli selection (resulting from pre-questions) can be stronger than the direct instructive effects of pre-questions. Generalizing this conclusion to the present data would suggest that experience with the randomized versions of the test would

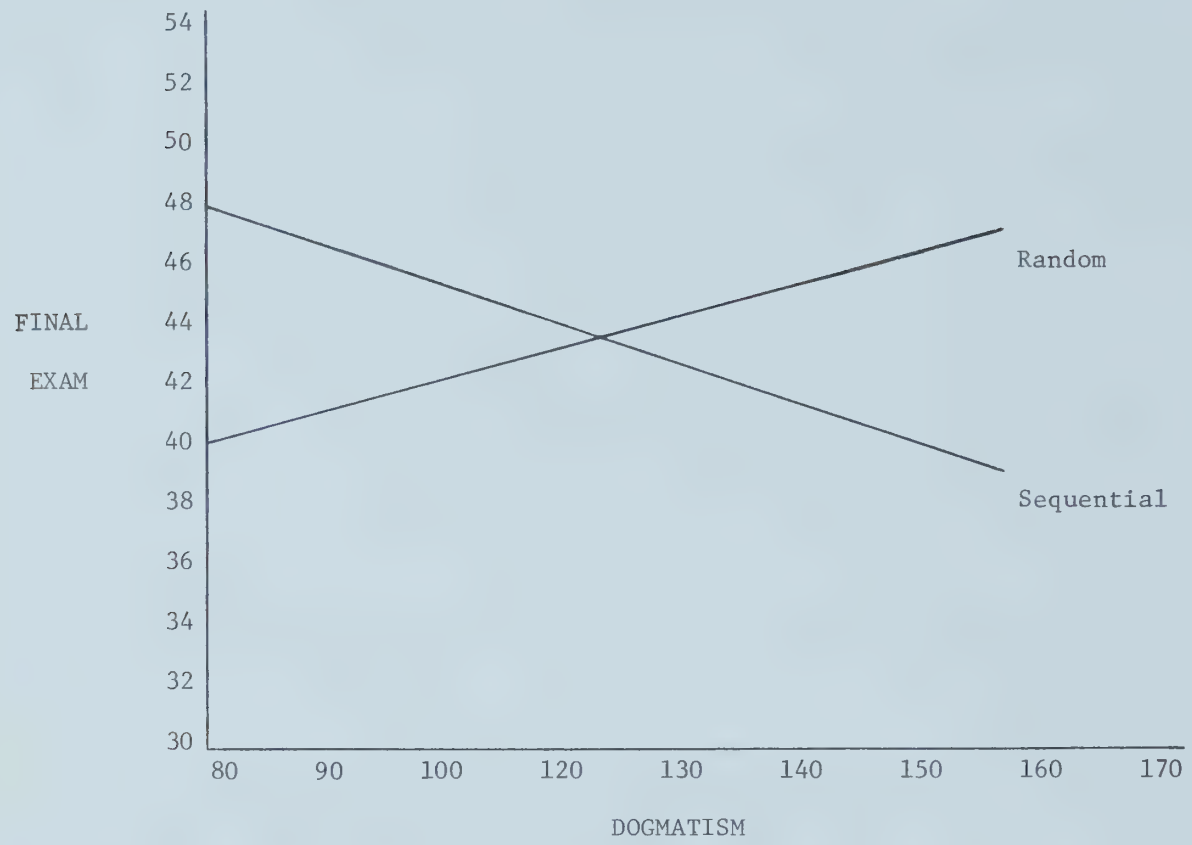

FIGURE 4

REGRESSION OF FINAL EXAMINATION SCORE ON DOGMATISM

decrease attention paid to the extrinsic structure of the material during subsequent learning, and hence reduce the detrimental effect of performance demands which do not follow the instructional order.

The data do suggest that the use of randomized tests yields learning which has greater generalizability to subsequent occasions. Reliance upon an externally imposed structure of the material may be unrealistic in terms of the subsequent demands made for the knowledge in applied situations. Certainly, procedures which enhance the recall of knowledge outside the instructional context would be consistent with the basic goals of education.

Table 3 indicates a clear relationship between debilitating test anxiety and test performance for three of the four criteria. The greater the person's debilitating anxiety, the poorer his performance. The relationship is especially marked for the final examination and the second quiz. Since the final examination weighed heavily in determining the course grades of students, this result is entirely consistent with the theory behind the Achievement Anxiety Scale.

Quiz 2 involved the use and understanding of statistical concepts, and the significant negative correlation between student's scores on it

and their debilitating anxiety scores is consistent with both theory and intuitive impressions as to what is anxiety producing for graduate students. The interaction displayed in Figure 1 further amplifies this relation. When achievement anxiety is high, and when the situation is presumably anxiety producing, performance on a randomly ordered test is inferior to performance on a sequentially ordered series of the same items. The higher one's achievement anxiety, the more detrimental is the effect of departure from the externally imposed order of the material.

Figure 2 suggests that reliance on the extrinsically imposed order of the material is greatest for those subjects who initially knew least about the subject matter. When this order was destroyed, their performance was markedly inferior. While this may indicate that sequential instruction is an important aid for the more naive student, it also indicates the fragile nature of their grasp of the knowledge. It would certainly be a mistake to assume that the performance of such students on a sequentially ordered version of the test reflects a firm grasp of the subject matter.

It was assumed at the outset of this research that the random form of the tests represented an ambiguous situation for students. That is, lack of structure was equated with ambiguity. As such, it was thought that subjects with a high intolerance for ambiguity would perform more efficiently on the sequential (structured) versions of the tests. The results indicate just the opposite occurred. It is difficult to interpret why this should have happened, but one very tentative explanation is offered. If the initial assumption was correct, then it is possible that the subjects ranking high on this variable may have responded to the ambiguity by working with increased diligence and care in an attempt to reduce the ambiguity, thus resulting in a better test performance. It would have been informative to have recorded the length of time taken by each subject to complete the test. This might have provided the additional clues required to support this interpretation. Unfortunately, the researchers were not that foresighted.

A central position of Rokeach's (1960) theory of the organization of belief-disbelief systems is that the cognitive system of closed-minded persons (high dogmatic) is highly resistant to change. Further, a difference between high and low dogmatic persons is hypothesized in their dependence upon authority. Open-minded persons should be more able to distinguish the source of information from the quality of information than is the close-minded person. By a somewhat extensive extrapolation from the original theory, it was expected that the open-minded subject would be better able to differentiate the extrinsic structure of the material from the content itself, and hence they should be less effected by attempts to move away from this structure.

Again, the results obtained were contrary to the prediction. One not altogether convincing possibility is that the open-minded persons differentiated the structure from the content more than did the closed-minded persons, but, at the same time, they accepted the structure as reasonable, and hence, tied their learning firmly to it. They would therefore be at a disadvantage when the structural support for their learning was removed. At the same time, other research suggests that the closed-minded person paradoxically spends more time studying incongruent materials (Smith, 1968). So, again it may be that the high dogmatic persons took more time with the random form of the test, and hence, performed more adequately.

It is clear that there is nothing in the data or the theory which can lead to an assured interpretation of these results. The resolution of these difficulties will have to await further research.

Two remaining points are worth noting. Firstly, in the interpretation of the results it should be remembered that this study involved multiple administration of the treatments. On each occasion the tests were distributed randomly, and by the final examination the great majority of the subjects had experienced both randomized and sequential test forms. Although the data in Table 2 suggest that the immediately previous test had an effect on the next test results, the combined effects of multiple treatments could not be assessed.

Secondly, the correlations in Table 3, the fact that significant interactions were only found with Quiz 2 and the final examination scores as criteria, suggest the importance of motivation in obtaining results in such studies. Had the study been conducted under conditions with less ego involvement for the subjects, the results might have been lost. The recent study by Frase *et al.* (1970) has indicated the importance of incentives in determining the effects of questioning upon learning. It is apparent that one asset of studies of the present type, conducted as part of the on-going classroom experience of students, is the seriousness and high level of motivation of the subjects. It is under such conditions that individual differences that relate to learning are most likely to play a role.

References

Alpert, R., & Haber, R. Anxiety in academic achievement situations. *Journal of Abnormal and Social Psychology,* 1960, *61,* 207-215.

Budner, S. Tolerance of ambiguity as a personality variable. *Journal of Personality,* 163, *30,* 29-50.

Ebel, R. *Measuring educational achievement.* Englewood, N.J.: Prentice-Hall, 1965.

Ehrlich, H., & Lee, D. Dogmatism, learning, and resistance to change. *Psychological Bulletin,* 1969, *71,* 249-260.

Fillenbaum, S., & Jackman, A. Dogmatism and anxiety in relation to problem solving. *Journal of Abnormal and Social Psychology,* 1961, *63,* 212-214.

Frase, L. Effect of question location, pacing, and mode upon retention of prose material. *Journal of Educational Psychology,* 1968, *59,* 244-249 (a).

Frase, L. Questions as aids to reading: some research and theory. *American Educational Research Journal,* 1968, *5,* 319-332 (b).

Frase, L. Some unpredicted effects of different questions upon learning from connected discourse. *Journal of Educational Psychology,* 1968, *59,* 197-201 (c).

Frase, L., Patrick, E., & Schumer, H. Effect of question position and frequency upon learning from text under different levels of incentive. *Journal of Educational Psychology,* 1970, *61,* 52-56.

Rokeach, M. *The open and closed mind.* New York: Basic Books, 1960.

Rothkoph, E. Two scientific approaches to the management of instruction. In R. Gagne and W. Gephart (Eds.), *Learning research and school subjects.* Itasca, Illinois: Peacock, 1968.

Rotter, J. Generalized expectancies for internal versus external control of reinforcement. *Psychological Monographs,* 1966, *80,* Whole No. 609.

BOOK REVIEWS

MEXICAN AMERICANS IN SCHOOL: A HISTORY OF EDUCATIONAL NEGLECT.

By Thomas Carter. New York: College Entrance Examination Board, 1970, 235 pp.

This book is an indictment of the American school system for its treatment of its Mexican American students in five southwestern states. Relying heavily upon studies done on Mexican American performance in and attitudes toward the school as well as a host of personal interviews, Carter convincingly argues that the public schools of California, Arizona, Colorado, New Mexico and Texas offer little in the way of opportunity or educational development to students of Mexican American backgrounds.

The evidence cited within the book clearly indicates that Mexican Americans are confronted by many difficulties that are characteristic of minority groups throughout the United States. High dropout rates, low academic achievement levels, few high school graduates, poor self concepts, and consequently basically low average incomes are among the major problems plaguing Mexican Americans. Much of Carter's book is devoted to examining the factors underlying these problems.

The most commonly offered explanation for the poor performance of Mexican Americans in school is that they are "culturally deprived" that is certain aspects of their home lives and socialization patterns interfere with or prohibit high levels of academic achievement. Children of Mexican American heritage are often pictured as being lazy, dirty and shiftless with a distinctly manana orientation that effectively outlaws the development of the competitive aggressiveness that is associated with success within American society. Carter demonstrates that this stereotype of the Mexican American is applicable in only certain isolated rural areas and is not characteristic of the group as a whole. He likewise rejects lower innate IQ and bilingualism as causal factors in the poor school performance of Mexican American students. The basic issue according to Carter is not with the Mexican American's approach to school but rather with the schools approach to Mexican Americans. He contends that the school has traditionally taken children in and expected them to change to meet its requirements rather than making adjustments within itself to meet the needs of its students. The high dropout rates and poor academic showings of Mexican Americans are indicative of the school's failure to assimilate and educate minority group students. The problems encountered by Mexican Americans in schools will not be alleviated until the school changes

and proves itself receptive to the needs and aspirations of all minority group students.

Carter suggests a number of ways in which schools might change themselves to better serve their Mexican American students. He asks for experimental bilingual schools which would employ both Spanish and English as languages of instruction as well as programs of teacher preparation that would emphasize training in cultural sensitivity and awareness to better equip teachers to deal with minority group students. Most important of all, Carter pleads for institutional self analysis on the part of the school to determine its educational and social role vis-a-vis Mexican Americans. If as he suggests, the school is influential in keeping the working force full of uneducated, semi-illiterate cheap laborers, then administrators, teachers and school systems should recognize their contribution to the situation.

The problems that Mexican Americans face in the schools are indicative and reflective of the difficulties they encounter in the society at large. Until changes occur in both these sectors, there will be little opportunity for Mexican Americans to play a significant part in American society.

D. WANGLER
The University of Alberta

ESSENTIALS OF PSYCHOLOGICAL TESTING (Third Edition)
By: Lee J. Cronbach. New York: Harper and Row, Publishers, 1970. 694 pp.

The third edition of *Essentials of Psychological Testing* is similar to the second edition with respect to purposes and organization. In the older edition reference is made, in the preface, to "a basic course in testing" while in the newer edition the author states that the book should "establish a base" upon which new knowledge can grow. Although the organization is largely unchanged the third edition represents essentially a complete rewriting.

The book consists of three parts. Part I, Basic Concepts, includes three introductory chapters providing information on test history, purposes, and test administration. The remaining three chapters deal primarily with statistical concepts necessary for scoring and norming, validity of tests, and reliability. Part II, Tests of Ability, describes the theory and methods of mental testing, the nature of individual and group tests, the value of factor analysis, specialized tests and profiles, and uses of tests in personnel classification. Part III, Testing of Typical Performance, deals with measurement of interest, and problems and methods of personality assessment.

Part I seems to be the weakest section largely because it says too much or too little. Chapter four, Scoring, describes very briefly such concepts as the mean, standard deviation, percentiles, and the normal distribution. While it is understandable that a book on measurement need not be a statistics text, there is no suggestion by the author that the reader need consult other sources. There is an implication that the treatment of statisical concepts is sufficient when the author takes the trouble to include computation methods for determining percentiles, standard scores, and Spearman rank-order correlation coefficients. If students have to be shown how to perform these computations, discussion in subsequent chapters of such things as the computation of a two-way analysis of variance, coefficient alpha, and factor analysis is going to be far beyond the students' competence. A simple solution might have been to list a few statistical concepts required, then refer the students elsewhere if they are not familiar with the terms.

The author's treatment of the concept of reliability is different from that found in most texts. Unlike other sources, the term is introduced *after* a discussion of the errors of measurement. The term, in fact, is almost ignored at first in favor of the term "generalizability". The development is more mathematical in character than is usual. It would appear that the explanation provided in this text would be meaningful only to students who had a background in statistics well beyond what is ordinarily encountered in students at a level where *Essentials of Psychological Testing* serves as a text. Bluntly stated, it is likely that a majority of students would find much of chapter six incomprehensible.

Part II is excellent with respect to both content and interest. The

discussion of the development of intelligence testing and present stage of research and theory is much more comprehensive than the discussions found in most measurement texts.

Part III represents a comprehensive and workmanlike treatment of the area of testing of typical performance. The coverage is much more complete (240 pages) than in most texts. There is sufficient material, both in range and depth, to serve as a text for a course on interest and personality assessment. The author maintains interest in Part III, as well as in Part II, by drawing upon experience in the field and by generous references to the literature.

Two rather minor but nonetheless jarring features of the text should be mentioned. First, there are apparent oversights that should have been caught before they were printed. One example, appearing on page 103, will likely cause confusion—"If almost everyone can count, and almost no one can carry a tune, the fiftieth percentile on the former means poor performance and the fiftieth percentile on the latter is good . . ." On page 163 figure 6.3 is a poor example in that it appears to be in error. The broken lines does not, as stated, show the average score in each column.

The second questionable feature is the author's propensity for stating value judgments as facts. For example, on page 98 age norms and grade norms are condemned, but the reasons given are applicable to a number of other kinds of norms as well. Another example occurs on page 164 where the technique of establishing the 95 per cent confidence interval described in many texts "cannot be recommended".

A comparison of the second and third editions reveals a few changes. Chapter eight, General Ability: Research and Theory, in the third edition is new and represents a valuable addition. The primary contribution of this chapter is to anchor ability measurement firmly in the field of psychology. Chapter 13, Proficiency Tests, of the second edition does not appear in the new edition. The author claims that this area has grown so that it now requires "book-length treatment". The new edition is eighty-six pages longer than the previous edition, and in addition smaller type is employed.

Essentials of Psychological Testing would certainly be of value as a text. Part II and Part III deal with testing of ability and of attitudes as adequately as any text in the field. This reviewer suggests, however, that basic concepts of Part I are more effectively dealt with in Stanley's *Measurement in Today's Schools* or Thorndike and Hagen's *Measurement and Evaluation in Psychology and Education.* There would be disadvantages therefore in using the book as a single text for a course in psychological measurement. As a prospective text in an educational measurement course it would have the additional disadvantage of not dealing with achievement testing nor with test construction. However, the value of the book as a reference in these courses is not questioned.

V. R. NYBERG
The University of Alberta

THE DISCERNIBLE TEACHER

By John Macdonald. Ottawa: Canadian Teachers' Federation, 1970

It is unfortunate that the words "teacher education" do not appear in the title of this publication, because that is what it is about. Commencing in 1965 the Canadian Teachers' Federation chose this theme for study and activity, culminating in 1970 with the publication of *The Discernible Teacher.* Dr. Macdonald had the benefit of discussions with a panel of experts and a trial by fire in a number of seminars sponsored by the CTF. These experiences no doubt influenced his thinking.

We hesitate to call the publication a book because of its length (about 35,000 words) and format. It has four chapters: Some Problems of Teacher Education, Professionality, the Discernible School, and Teaching and Contemporary Society. Commendably, the proposals for teacher education are presented first, since the *Preface* states that Dr. Macdonald's assignment was "to work out a tenable philosophy for teacher education in Canada".

The approach adopted is a critical analysis of the problem. Macdonald asserts that the effect of teacher education on subsequent teacher behavior is limited. He offers three possible explanations: lack of functional value, rejection by teacher candidates of what is offered as teacher education, or resistance by the schools and their current teachers because they posses an established doctrine which won't brook competition. Why might teacher candidates reject what is offered during teacher education? Macdonald characterizes them as intelligent and capable but as a group deficient in members with very high intelligence, as having a strong practical bent but lacking interest in truly intellectual matters, and as being conservative, that is, resistant to change and reform. These characteristics in turn are traced to lower middle class origins. The established doctrine (or operational doctrine) of the schools is reinforced by administrative controls which maintain the status quo and resist efforts to change. He asserts that "in the present state of educational knowledge, it is impossible to make any kind of detailed statement about the components of a substantiated teacher education program" and instead list five conditions required if teacher education is to affect teacher behavior. These conditions were devised with the problems previously analyzed in mind:

1. The teacher education program must be based on a thorough analysis of teaching as a task, from which models of teacher behavior could be derived.
2. The program must provide for assessment of teaching performance following teacher education.
3. Teacher education must be the concern of the whole educational system.
4. There must be organized provisions within the educational sys-

tem for research on teaching and for evaluation of teaching performance.

5. The first graduates from such a program must remain in touch with the teacher education institution.

Macdonald then proposes procedural steps for implementing these five conditions. He calls the resulting proposal an *Integrated Teacher Education Program.*

A review of this publication must include the eloquent description of what Macdonald calls the *omnicapable teacher.*

> Teachers are invited to refer themselves to an omnicapable model, at once intelligent and affectively warm, knowledgeable and tolerant, articulant and patient, efficient and gentle, morally committed and sympathetic, scholarly and practical, socially conscious and dedicated to personal development, fearless and responsible. They are told that they must be specialists in an academic discipline, master of the techniques of presentation, adept class managers, artful motivators, skilful diagnosticians, ingenious remedial workers, imaginative curriculum designers, eager inquirers, efficient administrators, helpful colleagues, widely interested citizens, and loving human beings (the last being a new and very modish injunction). This rush of adjectives, so much in play when educators talk about teaching, can be summarized in a single phrase: teachers are, or ought to be, secular priests.

As the reader can well guess, this is part of a plea for teachers to be functional specialists, not generalists. Macdonald also suggests that the triad of teacher-class-school may be broken down, and that in the future schools may not consist of a building in one location. These views of the functions of teachers and of the nature of schools are supplemented by the chapter on contemporary society, a chapter which further delineates the context in which teaching may occur.

Macdonald has analyzed and discussed a number of problems in teacher education. His involved sentences with their complex structure do not make for easy reading. This difficulty is worth overcoming in order to grasp the framework which he presents for teacher education. As could be expected of so short a publication, detailed descriptions for teacher education programs are not included. Whether one agrees or not with his analysis of the problems which beset teacher education, this publication provides one more analysis of the current situation and prescribes one more solution for the problems analyzed.

S. C. T. CLARKE
The University of Alberta

NOTES ON CONTRIBUTORS

C. S. BUMBARGER holds the degrees B.S. from the Oregon College of Education and M.Ed., and D.Ed. from the University of Oregon. Dr. Bumbarger was Assistant Professor and Director of the Bureau of Educational Research at the University of Oregon. He is presently Associate Professor of Educational Administration at The University of Alberta. Dr. Bumbarger has published and been associated with numerous publications in the fields of educational research and educational administration.

S. C. T. CLARKE was a member of the Department of Educational Psychology at The University of Alberta from 1950 to 1958. From 1958 to 1968 he was Executive Secretary of the Alberta Teachers' Association. He returned to The University of Alberta in 1969 and currently holds appointments as Director of Summer Session and Evening Credit Program and Professor of Educational Psychology. Dr. Clarke is also Executive Secretary of the Alberta Advisory Committee on Educational Studies.

A. J. CROPLEY was lecturer in Psychology at the University of New England, Australia from 1965 to 1967. He is presently Associate Professor of Psychology at the University of Saskatchewan. Recent publications include articles in *The Journal of Consulting Psychology, Developmental Psychology, The British Journal of Psychology, The Australian Journal of Psychology, The British Journal of Social and Clinical Psychology, The British Journal of Educational Psychology, The Journal of Biosocial Science.*

DAVID FRIESEN is Associate Professor of Educational Administration at The University of Alberta. Dr. Friesen has conducted research into student attitudes and values, teacher-administrator relationships and decision making. Recent publications include articles in this Journal, *The Manitoba Journal of Educational Research, The Canadian Administrator, The C.S.A. Bulletin,* and *Adolescence.* Dr. Friesen has also published a monograph entitled *The Urban Teenager.*

P. F. GROSS holds an M.Sc. degree from the University of New South Wales and was Associate Professor of Administration and Director of the Computer Centre at the University of Saskatchewan at Regina. Dr. Gross is presently a Woodrow Wilson Fellow at Princeton, and part-time consultant to the U.S. Department of Health, Education and Welfare and the World Health Organization. He has had wide experience in Civil Engineering and in the Computer field. Recent publications include books on Management Information Systems and Computer and Health Planning (both in press), numerous journal articles and papers to national and international conferences.

JOHN HRITZUK holds the degrees B.A., B.Ed. from the University of Saskatchewan, and M.Ed. from the University of British Columbia; he is presently completing doctoral studies it The University of Calgary. He has taught in high schools and is presently Associate Professor in the Educational Psychology Department, University of Calgary. Recent publications include articles in *Contemporary Psychology, The Canadian Psychologist, Soviet Psychology, The Canadian Family Physician* and *Medical Monographs.*

HENRY JANZEN holds the degrees B.Ed. from the University of British Columbia and M.Ed., and Ph.D. from The University of Calgary. He has taught in high school and junior college and was, for three years, part-time school psychologist. He is presently Assistant Professor at the University of Manitoba. Recent publications include articles in *The Alberta Psychologist* and *The Canadian Psychologist.*

VICTOR MESSIER holds the degree of M.S. in Physical Education from The University of Alberta. He is presently engaged in doctoral studies in the Division of Individual and Family Studies at the Pennsylvania State University.

VERNER R. NYBERG holds the degrees B.Sc., B.Ed., and M.Ed. from The University of Alberta and Ed.D. from U.C.L.A. He is presently Associate Professor at The University of Alberta. His special interests are psychological measurement and construction of classroom tests.

RICK ODEGAARD holds the degree B.A. in Economics from the University of Western Ontario. He is presently a Research Assistant with the Alberta Human Resources Research Council. He has also had experience in industry and in secondary school teaching in Ontario.

DONALD L. PETERS holds the degrees M.Ed. from the Northeastern University and Ph.D. in Educational Psychology from Stanford University. He is presently Assistant Professor of Human Development at Pennsylvania State University. Recent publications include articles in *The Merrill-Palmer Quarterly, Child Development, The Journal for Research in Mathematics Education* and *The California Journal for Instructional Improvement.*

HELEN L. PIERCE holds the degrees B.Ed., and M.Ed. from The University of Alberta. Miss Pierce has taught in elementary and junior high schools and was a part-time instructor at the Camrose Lutheran College. She is presently Associate Professor in the Department of Educational Foundations at The University of Alberta. Previous articles by Miss Pierce have been published in this Journal.

DAVID SHAPIRO holds the degrees B.A., from the University of Michigan and M.A. in Economics from Princeton University where he is presently engaged in doctoral studies. He was a Doctoral Fellow with the Alberta Human Resources Research Council, 1969-1970; he has also lectured in Economics at the University of Western Ontario.

D. G. WANGLER is presently Assistant Professor, Department of Educational Foundations at The University of Alberta. Dr. Wangler served with the U.S. Peace Corps in Iran, 1962-1964 and returned to teach at the University of New Mexico. He is at present making a critical examination of the Colleges of Education and his findings will be available shortly for publication.

THE ALBERTA JOURNAL OF EDUCATIONAL RESEARCH

Table of Contents—Volume XVI, 1970

Altmann, Harold A. *Factors in the initial interview related to counselling continuation and termination.* No. 3, September, 131-135.

Atherton, P. J. *Financing post-secondary education in Alberta.* No. 3, September, 137-148.

Bumbarger, C. S., and Friesen, D. *An experiment in attitude change.* No. 4, December, 211-216.

Burt, David L., and Knill, W. D. *A comparative study of different modes of presentation on efficiency of learning and retention.* No. 3, September, 149-156.

Butterworth, Paul, Klein, James A., and Galloway, Charles G. *The modification of syntactic style through modelling.* No. 2, June, 95-101.

Chabassol, David. *Prejudice and personality in adolescents.* No. 1, March, 3-12.

Cheong, George S. C. *Acquisition of experimental attitude by young children.* No. 3, September, 157-163.

Cosens, Grace V., and Jeffares (Fast), Dolores J. *Effect of socio-economic status and auditory discrimination training on first-grade reading achievement and auditory discrimination.* No. 3, September, 165-178.

Cropley, A. J., and Gross, P. F. *The effectiveness of computer-assisted instruction.* No. 4, December, 203-210.

Diemert, Norman E., and Holdaway, Edward A. *Teacher satisfaction in team and conventional teaching situations.* No. 2, June, 111-122.

Eddy, W. P. *The relationship of role orientation of teachers to organization of schools.* No. 1, March, 13-21.

Friesen, D., and Bumbarger, C. S. *An experiment in attitude change.* No. 4, December, 211-216.

Fitzgerald, Donald, Maguire, Thomas O., and Mullen, Robert F. *A computer program for drill in basic number operations.* No. 2, June, 89-94.

Galloway, Charles G., Butterworth, Paul, and Klein, James A. *The modification of syntactic style through modelling.* No. 2, June, 95-101.

Gross, P. F., and Cropley, A. J. *The effectiveness of computer-assisted instruction.* No. 4, December, 203-210.

Gulutsan, Metro, and Saruk, Alec. *Academic performance of students and the cultural orientation of their parents.* No. 3, September, 189-195.

Hersom, Naomi. *Organizational dimensions of schools.* No. 2, June 63-77.

Holdaway, Edward A., and Diemert, Norman E. *Teacher satisfaction in team and conventional teaching situations.* No. 2, June 111-122.

Hostetler, John A., and Thompson, Laura. *The Hutterian confession of faith: A documentary analysis.* No. 1, March, 29-45

Housego, I. E., and Manley-Casimir, M. *Equality of Educational Opportunity: A Canadian Perspective.* No. 2, June, 79-87.

Hritzuk, John, and Janzen, Henry. *A Soviet and Western concept of Set.* No. 4, December, 217-225.

Janzen, Henry, and Hritzuk, John. *A Soviet and Western concept of Set.* No. 4, December, 217-225.

Jeffares (Fast), Dolores J., and Cosens, Grace V. *Effect of socio-economic status and auditory discrimination training on first-grade reading achievement and auditory discrimination.* No. 3, September, 165-178.

Klein, James A., Butterworth, Paul, and Galloway, Charles G. *The modification of syntactic style through modelling.* No. 2, June, 95-101.

Knill, William D. *Information storage and retrieval for educational research: A progress report.* No. 1, March, 23-27.

Knill, W. D., and Burt, David L. *A comparative study of different modes of presentation on efficiency of learning and retention.* No. 3, September, 149-156.

Maguire, Thomas O., Fitzgerald, Donald, and Mullen, Robert F. *A computer program for drill in basic number operations.* No. 2, June 89-94.

Manley-Casimir, M., and Housego, I. E. *Equality of educational opportunity: A Canadian perspective.* No. 2, June, 79-87.

Messier, Victor, and Peters, Donald L. *The effects of question sequence upon objective test performance.* No. 4, December, 253-265.

McLeish, John. *Students' attitudes to teaching methods.* No. 3, September, 179-187,

Mullen, Robert F., Fitzgerald, Donald, and Maguire, Thomas O. *A computer program for drill in basic number operations.* No. 2, June, 89-94.

Odegaard, Rick, and Shapiro, Dave. *Salary structure and education of Alberta teachers: an economic analysis.* No. 4, December, 227-240.

Peters, Donald L., and Messier, Victor. *The effects of question sequence upon objective test performance.* No. 4, December, 253-265.

Pierce, Helen L. *Changes in the elementary and junior high school ecology in an urban school district.* No. 4, December, 241-252.

Saruk, Alec, and Gulutsan, Metro. *Academic performance of students and the cultural orientation of their parents.* No. 3, September, 189-195.

Shapiro, Dave, and Odegaard, Rick. *Salary structure and education of Alberta teachers.* No. 4, December, 227-240.

Stuhr, Christian A., and Wright, E. N. *Marks and patterns of parental mobility in a downtown school.* No. 1, March, 47-55.

Thompson, Laura, and Hostetler, John A. *The Hutterian confession of faith: A documentary analysis.* No. 1, March, 29-45.

Wiens, John. *Differences between influential and non-influential administrators.* No. 2, June, 103-110.

Wright, E. N., and Stuhr, Christian A. *Marks and patterns of parental mobility in a downtown school.* No. 1, March, 47-55.

THE CANADIAN ADMINISTRATOR

DEPARTMENT OF EDUCATIONAL ADMINISTRATION
THE UNIVERSITY OF ALBERTA
EDMONTON 7, ALBERTA

This is an invitation to subscribe to the CANADIAN ADMINISTRATOR, an educational journal of particular interest to school personnel who have coordinative and supervisory responsibilities. The CANADIAN ADMINISTRATOR, now in its tenth year, publishes articles based mainly on research done in the Canadian setting. The intent is to assist leadership personnel in education to keep up with developments in their field by presenting research findings and discussing their implications in non-technical language.

SUBSCRIPTION RATES

Individual Subscription (8 issues per year, October through May)

1 year	$3.00	Deduct 25c if payment accompanies order.
2 years	$5.00	
3 years	$7.00	

Multiple Subscriptions to the Same Address:

2 copies per month	$2.50 per subscription
3- 9 " " "	2.25 " "
10-25 " " "	2.00 " "
26-99 " " "	1.75 " "
100 or more copies per month	1.50 " "

Back Issues: Complete sets of Volumes I (1961-62) to IX (1969-70) are available at $2.00 per volume (8 issues).

INTERCHANGE: A JOURNAL OF EDUCATIONAL STUDIES

Interchange, a quarterly journal of the Ontario Institute for Studies in Education, is committed to the development and integration of theoretical perspectives and empirical research in education.

Partial Contents of Forthcoming Issues

Vol. 1, No. 3

B. R. Joyce —Comprehensive Reform in Teacher Education

R. M. Gagné —Structured Experience and Pre-Planned Learning

J. F. Wohlwill —Reply to Gagné

E. J. Haller and S. Thorson —Political Socialization

D. E. Hunt —Coordinating Learner Characteristics and Educational Approaches

H. Sinclair —From Sensory-Motor Behaviour to Symbolic Activity

Symposium on Developments in Multi-Variate Analysis:
M. Fullan, W. G. Spady, S. Carlos, R. Morris, D. Nolle

Vol. 1, No. 4—Education for the Future

M. McLuhan —Education in the Electronic Age

H. Passow —Urban Education in the 1970's

E. Litwak, *et al.,* —Community Participation in Bureaucratic Organizations

M. Holmes —An Empirical Critique of Neo-Progressive Trends

A. McNaughton —Curriculum as an Instrument of Change

Subscription rates: students—$3.00 per year; other individuals and libraries—$5.00 per year; single issues—$1.50 each.

Remittance is requested by cheque or money order, payable to OISE.

Mail to: Publication Sales, OISE, 252 Bloor Street West, Toronto 5, Ontario, Canada.